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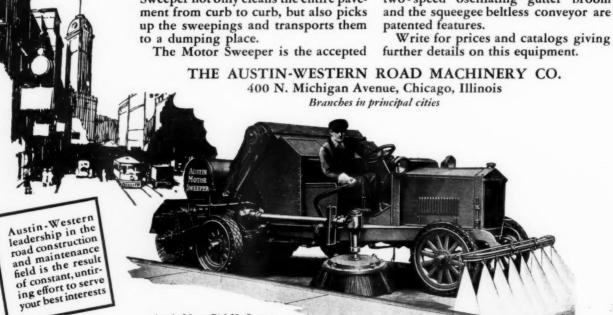
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PUBLIC WORKS.

CITY

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A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 59

April, 1928

No. 4

Refuse Disposal in Providence

Change from contract collection and hog feeding to municipal collection and incineration. Collection procedure. Garbage wrapped. Organization. Unusually complete system of recording details of collection and incineration

By David D. Bouchard

Providence, Rhode Island, with a population of about 270,000, until last year relied on private companies and individuals for gathering household refuse. Most of the garbage was carried to piggeries in outlying parts of the state. With rapidly increasing population, however, the individual concerns became apparently unable to cope with the situation, and the city some time ago appointed a committee of engineers and sanitarians to devise means whereby the work could be done under municipal supervision.

The idea of a city hog farm was abandoned because no land could be found which would not soon be rendered unserviceable by the growth of the city, property and because of complaints which would result from any slight odors the incinerator might give off.

The plant is similar to others installed by the same company in several large cities in the East. It is housed in a building 61 feet by 99 feet inside dimensions. Adjacent to it was built a garage adequate for the fleet of collection trucks, also a 10,000-gallon filling station and a scale house.

As the land on which the incinerator is built is too small to allow the construction of a ramp by which the trucks could be driven directly to the charging room on the second floor, it was decided



PROVIDENCE GARBAGE COLLECTION TRUCKS

while suburban towns and villages strenuously objected to having garbage carted through their streets, and at any time the farms might be put out of service by injunctions obtained by townships in which they are situated. Investigation was made of the methods employed in cities located east of the Mississippi river, and the committee finally recommended the purchase of a Decarie two-unit incinerator. Two units were considered desirable so that, if one unit should at any time need repairs, the other could carry on with continuous operation without greatly interfering with the service.

THE INCINERATOR

The site selected for the new plant is in a manufacturing district about 1½ miles from the center of the city. Location in a residential area was avoided because of the tendency such a plant would have to depreciate the value of the surrounding

to adopt the plan employed in New Orleans, and an electric crane was installed for lifting to the second floor the tanks in which the garbage is collected. Each truck is fitted with two specially constructed detachable tanks to permit of this. On reaching the plant, the crane hoists the loaded tanks to the hopper floor and empties their contents into the furnace.

Garbage and combustible refuse are burned in the incinerator. The city does not collect ashes or incombustible refuse. Approximately 125 tons of garbarge and rubbish is burned daily, the incinerator being kept in operation 18 hours a day and 6 days a week. The day is divided into two shifts of 9 hours each. The rubbish furnishes practically all of the fuel necessary for burning the garbage, although a little coal is needed for starting the fire in the morning. The incinerator is inspected and

cleaned regularly each week, usually on Sunday. In this way it is hoped to discover any defects and correct them before they become serious. Each load is carefully weighed when it arrives at the incinerator, and the weight recorded so that statistics vital to the efficient management of the system can be had. For the same reason, the time taken for collecting each load is kept. Garbage and refuse from commercial houses are accepted if delivered at the incinerator, and these also are weighed.

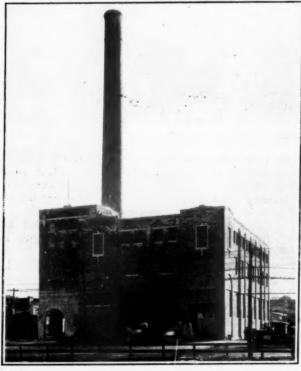
The incinerator plant is believed to be capable of destroying 160 tons of garbage and rubbish per day. It costs \$352,500.

COLLECTION

The method of discharging the refuse into the incinerator required the use of trucks to carry the collection tanks, and twenty $2\frac{1}{2}$ -ton Mack trucks, each equipped with two $1\frac{1}{2}$ 4-ton removable tanks, were purchased at a cost of \$42,531.

Collections are made three times a week in summer and twice a week in winter. Each truck is manned by a driver (who takes no part in collecting) and three collectors, all of whom work in 9-hour shifts. During the summer the collections begin at 6 A. M. and are completed at 3 P. M., and in winter they begin at 5 A. M. and are completed at 2 P. M. All help is permanent and the pay is on a weekly basis, so that there is no incentive to delay the work merely for the sake of gaining an extra hour's time.

When the day's collections have been completed the tanks are detached and lifted to the hopper room of the incinerator, where they are thoroughly washed and steamed and left to dry until morning, when they are again placed on the trucks. This insures excellent sanitation, and eliminates offensive odors;



BUILDING HOUSING PROVIDENCE INCINERATOR

Mills Photography Co., Providence

also allows frequent inspection and prompt discovery of any weaknesses which the tanks may have developed. Each tank is cleaned and inspected each night by its driver.

Two inspectors are held directly responsible for all collections. It is their duty to follow up all collection complaints and see that the refuse at no house is left ungathered. It also is their task to keep in contact with the truck crews throughout the day and speed up any that may be lagging. They also investigate failures on the part of householders to wrap their garbage properly.

Preliminary to planning collection routes, a study was made of the daily tonage to be collected from each section of the city, the miles to be travelled to the incinerator, etc. On the basis of this study the city was divided into 14 routes, arranged so as to make the ton-mileage as uniform as possible. Horses and wagons were considered for making the collections, but it was found after trial that much valuable time was lost to the collection crews awaiting the return of the empty wagons from the incinerator. Trucks not only carry a larger load but the saving in running time to and from the plant greatly facilitates the work. In making collections, the trucks cannot travel more than 2 miles an hour.

To facilitate the work of collection and also of incineration, a city ordinance was adopted, making it mandatory on househoulders to drain their garbage and wrap and tie it in substantial paper. It also provides that all waste paper, rags, old clothing, bedding or other combustible material be tied up securely to prevent it from scattering. Each houseowner or occupant is required to furnish at his own expense a covered, water-tight garbage receptacle. Collections are usually made from the rear of the house, but collectors are not permitted to take rubbish from hallways or from within the house. All matter to be collected must be left by the householder in a convenient and easily accessible place in the rear of the house.

Indignant protests from all parts of the city were heard when the requirements were first made known. Always badly served under the old method of collection, many bitterly resented what they regarded as an additional hardship. This attitude was shortlived. Those who grudgingly complied with the new ordinance soon discovered that the wrapping of garbage was not the distasteful task they imagined. Within a few days after the requirements had been put into effect, a survey was made to determine how the new system was being received. It was found that a great majority of those served were completely satisfied and declared that by wrapping garbage they were able to keep their kitchens cleaner and more sanitary with little or no added incon-

COST AND ORGANIZATION

venience.

In addition to the cost of incinerator and trucks, other outlays incidental to installing the new system included cradles, garages, concrete, etc., costing \$26,903; land, \$45,953; miscellaneous expenses \$15,845.

The personnel of the department at present numbers 96, which includes the superintendent, day engineer, night engineer, two inspectors, truck repair

man, eight firemen, two crane men, four hopper men, five floor men, watchmen, checker, two clerks, fifteen truck drivers, fifty collectors, garageman, and a chauffeur. The annual expenditure for salaries will total about \$194,000.

Under the old system, supervision of collecting and disposing of garbage had been under the control of the health department, but with the new plan going into effect it has been placed under the charge

of the Commissioner of Public Works.

Under the old contract system the annual cost of collecting and disposing of the garbage was about \$125,000. Although there are no figures available yet to determine the cost of operation, depreciation, etc., it is estimated that the new method will result in the expenditure of approximately \$225,000 a year. If the needs of the city are adequately cared for, as they most certainly were not in former years, city officials feel that the additional expense will be more than justified. Moreover, proper sanitation and not rigid economy is the attitude assumed by the city officials.

The new collection system and incineration of the refuse of the city were set in operation on November

1, 1927.

One of the features of the new system is the method used to ascertain the exact cost per ton of collecting and burning the refuse, including all expenses incidental to the operation of the collection, incineration and administration, such as labor, depreciation on equipment, repairs, fuel, etc. This necessitates a careful and systematic check on every detail of the work.

Under the new system, tonnage and collection records are kept in the following manner: Whenever a truck leaves the plant on collections, a small yellow slip, or ticket as it is called, is made out bearing the route number, driver's name, and truck number. On the card, the time leaving is punched in a place reserved at the bottom, which is marked off with the hours and quarter hours of the day. (A punch is used to eliminate the possibility of the time being

changed by the driver.)

When the loaded truck returns, it is run on the scales and the weight is recorded on the same ticket, on which space are provided for the gross, tare and net weights. At the same time, the time in is punched and the elapse time is recorded. When a truck makes collections as the result of a complaint, a "ticket" is filled out giving name and address of complainant, cause of complaint, time received, completed, and required. A similar ticket is used to record weight of refuse received from commercial houses.

As soon as these tickets are made out they are sent to the main office, where the information they contain is copied off on a larger report sheet. In this way it is possible to determine at the end of each day the number of loads, together with their weight and the number of complaints, received at the plant. Both the tickets and the large single report sheet are

carefully filed.

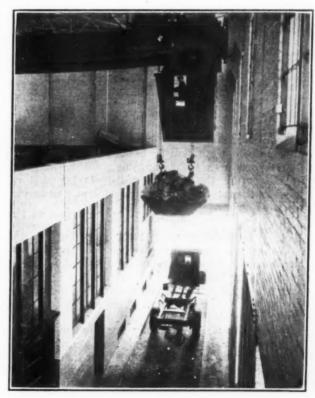
The daily report sheet of loads received has the following column headings: Route No.—Complaint No.—Ticket No.—Gross Weight——Net Weight—Time Out—Time In—Elapsed Time.

A car record is kept of each car, giving Car No.— Make—State Registration—Date Purchased—Style —Cost—Driver's Name. Also column headings: Date—Items—Gasoline—Oils—Grease—Tires and Tubes—Supplies—Labor—Material.

Also, a special monthly report sheet is filled out for the following items: Cost of Collection: Investigator — Truck Drivers — Collectors — Garage Labor—Equipment—Truck Repairs—Gasoline—Oil—Grease—Tires—Light—Water—Watchman (½ time)—Miscellaneous. Cost of Incineration: Engineers — Cranemen — Hoppermen — Firemen — Floormen—Laborers—Watchman—(½ time)—Oil—Grease—Light—Stationery, etc.—Telephone—Repairs — Water — Miscellaneous. Administration: Superintendent — Clerk — Weigher — Total Cost. Spaces are also provided for entering the number of tons of refuse collected during the month on each route, on complaint, and commercial. Also for cost per ton for collection, for incineration, and for administration. Also for number of complaints received, and the average time required per route.

It is necessary that the administration, collection and incineration departments each bear the expenses incidental to its operation if worthwhile records are to be available. No expense is omitted or charged haphazardly to the total operating cost, no matter how insignificant the item may seem. Even the stationery used and the telephone and light bills are distributed proportionately over the system.

By keeping adequate and accurate records, Providence officials find that it is a simple matter to determine at the end of each month just what is the cost per ton for collection, incineration and administration. From their statistics they can also tell how many tons were collected on each route, the



Mills Photography Co., Providence
RAISING REFUSE FROM TRUCK BY CRANE

average time per route, tonnage collected on complaints, and the amount of garbage and refuse received from commercial houses.

The Providence system is operated under the direct supervision of Frank E. Waterman, Commissioner of the Department of Public Works, and is known as the Garbage and Refuse Disposal Department. Irving Stone is superintendent in charge of the incinerator and collection system.

Dumping Rubbish at Oberlein

In his report for 1927 the village manager of Oberlin, O, D. F. Herrick, tells as follows of improvements made in the manner of disposing of the rubbish of the village:

"We have at last made a start in the right direction regarding the elimination of the public dump on North Main street. Through the efforts of the Business Men's Club a high board fence was constructed along the Main street side and on the north and south sides of the land for about 100 feet. The village has placed a new wire fence and new posts the remainder of the way around the property, replacing the old fence which had long ago passed its useful stage. A wide roadway was opened up from the gate down into the center of the dump and cinders were placed on this new road so that the danger of tire trouble was reduced to a minimum.

"The council has appropriated \$5,000 for equipment with which to bale the metal, in which shape it is possible to dispose of it at a fair market price. During the next year we hope to bale all this metal scrap and sell it at a figure which will enable us to make it a self-supporting proposition. The combustible material which remains will be burned and the ashes and bottles leveled off so that the piece of property will not be infested with rats and filth and will present a somewhat better appearance than it has the past decade.

"The dump is now open to the public on two days of each week and in this way we are able to supervise the disposal of the refuse which has heretofore been thrown any place and at any time. This supervision will be continued, as it is the only way in which we are able to create a semblance of order and organization at the dump. After the place is once cleaned up it will be but a small task to keep it in shape with the equipment already there, and in the future the citizens can feel they will not have to tolerate this most unsightly and unsanitary piece of ground."

Los Angeles Street Lighting

An artistic street lighting system different from any other in the country has been specially designed for Wilshire Boulevard, Los Angeles, by J. W. Gosling of the General Electric Company's illuminating laboratory. The lighting units, or lanterns, are larger than any ever before designed for this type of service. They are generally rectangular in shape and approximately 7 feet high, and are mounted on poles so as to bring the light center 22 feet above the street. In each lantern will be two incandescent lamps, one 2,500 candle power and the other 600 candle power.

A double wiring circuit will make it possible to operate either lamp separately or both together. It

is intended to use the brighter lamps from darkness until midnight and the smaller lamps from midnight until daylight, when traffic on the street will be so light as not to require much illumination.

Approximately 400 of the new lights have been installed 120 feet apart on either side of the street. The poles are of bronze-sprayed cast iron and the lanterns of cast bronze. In accordance with the general practice in Southern California of using the Spanish renaissance design for much of its street architecture, this style has been followed in the design of the lanterns and standards. Caryatids are used to support the cornice of the lanterns at the four corners, while the Los Angeles rose is used as a motif in the conventional decorations of the capitals.

Fire Hydrant Surveys

All hydrants thoroughly examined each fall, repaired when necessary and put in good condition. Winter surveys to detect freezing

By Frederick W. Albert*

Fire hydrants installed in connection with the distribution system of water mains in any community are of value and importance only in so far as they are available for instant use in case of need. The community has a right to insist upon the constant availability of these hydrants, whether the water system is a privately owned corporation or municipally owned and operated. In the final analysis, the citizens pay, in the form of either taxes or insurance rates, for fire protection.

Knoxville, Tennessee, during the past four years has spent about two and a half million dollars in rehabilitating its old water works and constructing a new supply and distribution system. This has included an entirely new pumping station and filtration plant; a ten-million-gallon and a one-million-gallon reinforced concrete reservoir; laying approximately 28 miles of trunk, feeder and distribution mains, and installing many additional fire hydrants and valves.

During these four years the Water Department

*Engineer in charge of Water Dept., Knoxville, Tenn.



STREET LANTERNS IN LOS ANGELES, CAL

has conducted four fire hydrant surveys. The time set is always in the fall of the year, in hope that the survey will be completed before the advent of freezing weather, which usually arrives about New Year's in Knoxville.

The first survey showed approximately 35% of the hydrants in need of repair in order to make them available for service. Many of these were two-hose-nozzle fire hydrants, which were immediately eliminated from the system so that now every fire hydrant in the city has a standard steamer connection in addition to two $2\frac{1}{2}$ -inch hose outlets.

The last survey of fire hydrants was begun on October 17, 1927, and completed January 27, 1928. Of the 1868 fire hydrants inspected, 1628 or 87.2% were found in first class condition. Seventy-one or 3.8% needed minor repairs, such as oil hole screws, cap chains, or chain hooks, etc.; while 148 or 7.9% were in need of major repairs, such as caps, valves, valve seats, upright valves and valve stems, etc. A total of 21 or 1.1% were found in such a condition as to call for their replacement, being of old make for which repair parts could not be obtained. All of these repairs were found necessary in spite of the fact that a complete survey of the fire hydrants had been made and the hydrants put in A-1 shape not more than a year previous.

Minor repairs are made necessary by carelessness in the removal of the cap by those who have permission to operate public fire hydrants. Conditions necessitating major repairs are caused by the operation of public fire hydrants by people who do not understand how to operate them and invariably employ extreme measures when cutting off or turning on the hydrants. In some cases two or three men will use a piece of pipe on the fire hydrant wrench and exert all their strength in efforts to either close or open the hydrants. This, of course, could be prevented if none but employees of the water and fire departments were permitted to use fire hydrants, but unfortunately, this restriction can not be obtained in this city.

SURVEY PROCEDURE.

The procedure employed in a fire hydrant survey in Knoxville is as follows:

The city is divided into sections and the inspectors begin on the outskirts and work towards the center of the distribution system. Each inspector has one machinist and one laborer, using a truck and the necessary tools and materials, in making the survey.

Upon reaching a fire hydrant he first takes readings of the static and residual pressures. He notes whether or not the caps and other parts of the hydrant are holding the pressure without leaking, whether they need new gaskets or other repairs. When the water is shut off, the steamer cap is immediately taken off and the inspector observes how the hydrant drains. If it fails to drain it is marked for a "dig out," or the inspector and assistants excavate around the hydrant to see that the drain holes are unstopped, and a new rock nest is placed.

The stuff nut is then removed, packing loosened and oiled so as to provide a satisfactory cut-off of water leaking up around the stem. If, after shutting down the hydrant, there is a constant flow, it is apparent that the valve is not properly shutting off. The valve is then opened and shut several times

so that if there is an obstruction under the seat it will be washed out. If this fails to stop the leak, the hydrant is put out of service by closing the valve on the connection, and the interior of the hydrant is then taken out. New valves, seat rings, stems and other major parts are replaced as needed. These comprise the major repairs to the fire hydrant.

The survey crew leaves the plant at 7:30 A. M. and returns at 4:30 P. M. with a half-hour out for

The cost of the latest fire hydrant survey amounted to 82 cents per fire hydrant inspected. The average cost of the minor and major repairs amounted to \$1.60, including the 82 cents for inspection. The total cost of the survey was \$1350. Ninety-one days of actual work were required to complete the survey, giving an average of 20 fire hydrants inspected and

repaired per day. The operation of the survey crews this winter (there were two during part of the time) was interrupted by extremely cold weather in the early part of January, when the temperature dropped to 2° below—the lowest level since 1917. With the arrival of freezing weather a number of small crews were sent throughout the distribution system to determine the condition of each fire hydrant, as it had been found that, even if a fire hydrant had recently been inspected and o.k.'d, subsequent operators may have failed to close the hydrants entirely, allowing water to leak into the barrel and freeze. This inspection seemed doubly necessary because it had been found that in extremely cold weather more fires occur than at other times of the year. This emergency inspection was proved to be justified by the fact that 103 fire hydrants were found frozen.

The department immediately put sixteen small crews of two or three men each to work inspecting and thawing out hydrants. Each inspector carried a hydrant wrench and a string with a lead weight on the end of it. Taking off the steamer cap and dropping the lead weight into the barrel, and knowing the depth of the valve below the steamer outlet, he could easily determine by the length of the cord dropped, weather the hydrant barrel was free or frozen. On finding a frozen fire hydrant, he immediately telephoned the location to the central office, and crews were sent out with thawing machines or with kindling and oil, and steps taken at once to thaw the frozen hydrants.

The number of calls upon the Fire Department during the ten days of extremely cold weather was greater than for any similar period in recent years, but as a result of the work done by the Water Department, the Fire Department had very little difficulty in handling all fires.

In view of the great savings of property which a fire hydrant survey makes probable, it seems to the writer that every community of a size to justify a water department such as exists at Knoxville, can well afford to adopt this practice of annual fire hydrant inspection.

Dynamiting an Ice Jam

A somewhat serious situation was caused this winter at Canton, New York, by high water in a small stream, known as Grass river, which had filled the cellars of homes and resulted in other

damage to property along the banks of the stream. To remedy the condition, 1250 pounds of dynamite were used to shatter the ice and permit the escape of the impounded water. Charges of 25 to 50 pounds of 60 percent dynamite, spaced about 150 feet apart, were used to make a channel through thick ice and lower the level of water.

Kansas City Water Works Survey

Report on present condition and operating efficiency of the plant, the sufficiency and economy in construction of the new plant, and the finances of the department. Universal metering advocated

Early in 1928 the Kansas City Public Service Institute submitted to Judge H. F. McElroy, city manager, and William F. Fleming, director of water, of Kansas City, Mo., a report on the Water Department of the city, which was prepared as the result of a quite extended analysis of the plant, the organization of the operating force, the operating methods, the financial condition and the needs of the

This study had been undertaken because there had been for a number of years charges of inefficiency in the operation of the plant, and a general belief that the department was overmanned and operated at an unduly high expense; because there was some question as to the exact financial condition of the department, and particularly whether it was self-supporting; and finally, because several requests had been made by the department for bond funds to provide for a considerable amount of extensions and improvements to the distribution system.

The department is completing a new supply plant which is the result of a number of years of study of possible methods of supplying an adequate amount of pure water. This plant, constructed by the proceeds of an \$11,000,000 bond issue during the past four years, is about to be put into operation and the old plant was not discussed in the report.

The investigators reported that they believed the bond issue money had "been spent in a manner to provide a plant capable of furnishing pure filtered water sufficient for the needs for a number of years. When the plant was first proposed it was expected that the water would be not only filtered but would be softened. The fact that price levels did not decline, as was expected, made it impossible to provide softening facilities within the \$11,000,000 limit." It is hoped that some time in the future the softening facilities can be provided and also the capacity of the plant somewhat increased.

More serious is the fact that the original plans for the expansion of the distribution system were to a considerable extent eliminated by the financial limitation

ORGANIZATION

The organization of the department is divided into

the division of administration, division of engineering, and division of collection. In 1926 there were 458 men employed in the engineering division, 113 in the division of collection, and 33 in the division of administration. The division of engineering includes all employees doing construction work on the distribution system, none of which work is done by contract. The total number of these varies from year to year. The investigators believed that in the collection division it should be possible to considerably decrease the number of employees. "The personnel is apparently subject to some political turnover, as all departments of the city government are. The total turnover, however, in the Water Department was less in the first year of the present admininistration than in any other department except the Fire Department, and the turnover within the Water Department was much less in the division of engineering than in either of the other divisions. It appears that turnover, while something of a problem, is not nearly as serious as in some other departments of the city government.'

The results obtained by the purification plant are reported to be very good considering the type of equipment used and the condition of the water when taken from the river. There has been a steady improvement in the purity of the water since 1920, whether measured by turbidity, number of bacteria, or number of B coli. The typhoid death rate in the city has steadily declined until now it is approximately one-third of what it was in 1921. This result was obtained without filtration, and with the completion of the new filter plant it is expected that the quality of the water will be very high.

FINANCIAL The four principal items of expenditure of the department are operation and maintenance, interest on bonds, improvements, and bond retirement. The department pays all of the costs except that for retirement of bonds, which is paid from the general tax. This, however, is more than offset by the fact that the department pays from earnings for a considerable amount of betterments, principally water main extension. In addition to these betterments. the department furnishes to other city departments a considerable amount of free service, primarily for the Fire Department, street cleaning, and parks. This free service is estimated in the report as costing the department approximately \$500,000, for the year 1927, while payments into the sinking fund were \$440,000.

In estimating the service rendered to the city by the plant, it was estimated that 20% of the increased capacity of the new plant was occasioned by providing capacity required by fire fighting. If to this be added the actual expense of maintaining hydrants and valves and the cost of new hydrants, this was believed to give as accurate figures as possible of the fire protection service rendered by the department. In 1926 there were 9,432 hydrants in St. Louis, 187 new hydrants were installed at the cost of \$28,100, and the maintenance of hydrants and valves cost \$99,315. Adding to this 20% of the interest, which equals \$117,835, and the estimated cost of water used or \$19,750, gives a total of \$263,000, or \$27.90 per hydrant.

The average charge for fire protection made by

those cities which in 1925 made such charge was equivalent to about 0.6 cent per inch-foot of pipe, with an allowance of \$8 per hydrant for maintenance, etc. On this basis, the charges for fire service in Kansas City would be approximately \$358 per mile of pipe plus \$8 for hydrants, or a total of \$30 per hydrant.

In addition to the free water furnished by the department, there is a considerable amount of water which is wasted or for other reasons does not return revenue. This was approximately 10% of the total amount of water in 1927. However, the wasted water has been reduced from nearly 20% in 1921, and the total amount of non-revenue water, including free water to city departments, has been reduced from $45\frac{1}{2}\%$ to $21\frac{1}{2}\%$.

In general, it appears that the department has earned more than sufficient to pay the cost of operation and maintenance, interest on bonds, and a limited amount of betterment expense. In addition to this, if other departments paid for free service at cost, the earnings would be more than sufficient to retire all bonds now outstanding, and in addition provide a surplus for further extensions and betterments.

The unit cost of operation of the Kansas City water system is high compared to that of many other systems. This is due primarily to the fact that, owing to the topography, most of the water must be pumped three times against a total head of over 400 feet. Reduced to cost per million gallons raised 100 feet, Kansas City's cost is still above the average, but the difference is not so great. Another condition increasing cost is that the raw water taken from the river is very dirty, requiring high expense for purification.

Compared with other cities, the rates in Kansas City are lower for very small and very large consumers, but higher for the others. Approximately 84% of the services are metered. The investigators believe that the policy of metering all services should be pushed vigorously and that serious consideration be given to a change from private ownership to department ownership of all meters.

The bids received for the new plant include \$2,-217,750 for tunnels; \$263,981 for grading, railroad siding, and bridge; \$683,394 for pumping station and equallizing reservoir; \$794,690 for conduits, pipes. valves, etc.; \$149,750 for motors, switch board and substation; \$72,742 for centrifugal pumps; \$3,168,506 for settling basins, filter plant and secondary pumping station; \$223,985 for intake and low lift pumping station; and \$51,599 for right-of-way. These totaled \$282,441 below the estimate.

It is interesting to find that the report by Fuller & McClintock, made in 1920, made a fairly close prediction of the population and consumption for the year 1927; the actual population as nearly as it could be estimated in 1927 being practically the same as that they had anticipated; while the consumption was anticipated as 54 million gallons and actually measured as 51.6 million.

The purification works are designed in units of eight filters, so that when needed an additional unit of eight, together with additional settling basin capacity, may be added. As stated before, softening

was not provided, as this would have required equipping the purification works with additional reaction tanks, preliminary basins, increased chemical building facilities, and possibly preliminary coagulating basins for complete softening, which would have brought the cost above the amount available.

Other features recommended by Fuller & Mc-Clintock which had to be abandoned were the providing of a new pumping station, although the old station was cramped and the piping extremely complicated. They had recommended that a new East Bottoms station be built for a major capacity pumping station, whereas Turkey Creek station has to continue in that capacity with the East Bottoms station serving as a peak load station only. The covering of the reservoirs also was omitted. Also about \$3,500,000 worth of water main extensions and improvements, this last being the most serious omission, which it is proposed to remedy at once if possible.

METERS

The meters used in the city are purchased by the consumers and thirty to forty different makes are in use. The city sells ½ inch meters to consumers at cost of purchase by competitive bidding. Disadvantages of the plan of private ownership are chiefly too high cost of meters to consumers (except those purchased from the Water Department) and unnecessary delays.

Concerning the latter, the report says: "When a meter is removed for repairs, another meter can not be set in its place, as the same meter must be returned to its owner. It is hard to remove meters for test purpose or repairs unless they have completely stopped registering, due to consumers' protests. Thus low registration often continues for indefinite periods. The cost of meters to consumers is increased in all sizes except \(\frac{5}{8} \)-inch which the city supplies. Obviously, there is an increased cost and carrying charge for repair parts for thirty or forty different makes of meters."

The investigators believe that the department could well afford to furnish all meters without charge in order to reduce excessive delays and repair costs, if it were not for the 70,000 meters already in use and owned by the property owners. However, a plan could be worked out whereby the meters already installed would be replaced by the department when worn out. The property owner would be required under this plan to pay for all repairs to the meters, as is now the case, until replaced. This plan would place the cost of all renewals and new service meters on the department; unless, of course, the renewal was due to gross negligence on the part of the owner.

"The consumer now makes a deposit of \$3.00, which is a guarantee that he will pay his bill when due, and has no relation to either the cost or preservation of the meter, through which he receives service. If the department owned the meters, changes could be made and tests conducted all at convenience and with actual saving both to the consumer and to the department. Since water meters inherently never over-register, it is extremely advantageous to be able to make changes in meters for repairs and test purposes in as short a time as possible. There are so few difficulties in the way of a changed meter policy and such substantial advantages

both to the consumer and the department, that it is strikingly peculiar that the present policy has continued so long without criticism."

The department has an annual pitometer survey made for leaks and wastes. This survey has been made by the Pitometer Company of New York for several years by contract. According to the last survey made, the apparent leakage in mains and services is very small. The percentages of free and wasted water for the years 1921 to 1926 inclusive have been 45.5, 36.9, 27.3, 24.5, 20.2, and 22.1, respectively. The largest known item occurring in the reduction in unaccounted-for water since 1920 has been the stopping of the use of sewer flush tanks. A great deal of waste has been stopped in mains and service connections, and the rate to some charitable institutions has been set at half price instead of without charge.

It is recommended that the department provide an organization for conducting continuous pitometer surveys, to do the work of the usual annual survey which is costing the city about \$35,000 a year, \$25,-000 to the Pitometer Company and \$10,000 for material and labor furnished by the department. Also that it make regular periodic pitometer measurements of all large free services not now metered, in order to obtain a fairly accurate approximation of the amount of water so used.

Separate Sludge Digestion

A series of articles giving the results of investigations and studies of several separate sludge digestion plants. The next will discuss sedimentation at these plants

Sludge Heating and Gas Collection at Antigo, Wis.*

By Anthony J. Fischer and Frank K. Quimby

RESULTS OF OPERATION

Sludge.-Except for a small amount drawn for demonstration purposes, no sludge has as yet been taken from the tank. The sludge is black in color, with a slight tarry odor, and appears to be thoroughly digested. Samples taken August 31st, when there was 4 feet of sludge in the tank, averaged 8.9% solids, the solid content of the bottom sludge being 9.5% to 10%. The ash content averaged 57.5%, which is high as compared to the raw material, which contains about 28% ash. There was a sharp line of demarcation between liquid and sludge. The liquid was fairly clear, dark in color, and contained about 0.3% total solids.

Solids Digested.—Tests show that an average of 428 pounds of dry solids is added to the digester per day. Of this, 252 pounds is digested and gassified, while about 20 pounds of the suspended solids is liquefied and goes out through the overflow along with 10 pounds of solids in suspension. This shows that the percentage reduction in solids is 59%, corresponding to a volatile matter reduction of 75%. These figures are remarkably high and clearly show that digestion is very satisfactory in this tank.

The present sludge storage capacity is 5.0 cu. ft. per capita, or 68 cu. ft. per pound of dry suspended solids added per day. From this it would appear that, with heating and careful control, the tank will take care of a 2.6-year sludge accumulation. results indicate that satisfactory digestion would be obtained with a much smaller capacity as the tank was designed to operate without heat.

Gas Production.—Gas measurements show that since the plant was started, up to August 31st, the

average daily production was 11.5 cubic feet per pound of original volatile solids added; or 15.4 cubic feet per pound of volatile matter destroyed. The gas production per capita (estimated) was 0.64 cubic foot per day. Since then the daily gas has increased, probably because of less line clogging, so that the figures are now actually a little higher, and present gas production is 0.8 cu. ft. per capita per

No gas analyses are available, but calorimetric tests made in June showed that the gas averaged 656

B.t.u.'s per cubic foot.

Average figures covering a period of 51 weeks, beginning with December 7th, 1926, are given in table 2. Figure 7 shows curves of gas production, temperatures, etc. All these curves are plotted from weekly averages.

Table 2. Average Results for 51 Weeks Beginning December 7th.

Total gas, 1,326,000 cu. ft.

Average daily gas, 3,710 cu. ft.

Average daily gas, 3,710 cu. 1t.

Average raw sewage temperature: day, 56.6°; night, 53.4°.

Average maximum air temperature, 56.5° (highest 96°).

Average minimum air temperature, 32.5° (lowest — 23°).

Average sludge temperature, 70.3° (highest 84°).

Average heating water temperature, day, 96.5° in, 79.2° out.

Average heating water temperature, night, 90.6° in, 77.9°

Average heat exchange (24 hours), 14.3°. Average heating water circulation, 1,700 cu. ft. per day.

Average heat added, 1,466,000 B.t.u. per day. Average heat used, 444,000 B.t.u. per day. Average heat lost, 1,022,000 B.t.u. per day.

Since the tank became full the average heat added has been 1,478,000 B.t.u. per day, and the heat lost 1,077,000 B.t.u. per day.

Average heat loss per pound of sewage per day (since tank was full), 0.6 B.t.u.

Average heat loss per sq. ft. tank surface per day, 162.5 B.t.u.

Efficiency of gas boiler (taking 1 cu. ft. gas = 700 B.t.u.) was 65.7% for 20-week period.

Efficiency of coal heater using gas as fuel = 31.8% for ten weeks.

^{*}Continued from page 101.

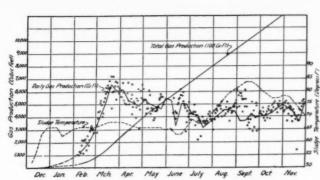


FIG. 7—DAILY AND TOTAL GAS PRODUCTION METERED AND SLUDGE TEMPERATURE

As gas measurements were made only since the tank was full (Feb. 7th) the first part of the total gas production curve was assumed to be as represented by the broken line. Here the gas is very low, due to the initial lag in digestion where organic acids are formed in considerable quantities and the pH value tends to drop off. After the cumulative effect of the raw sludge added during the first few months disappeared, the curve became practically a straight line having a slightly less slope than before; showing that digestion is progressing at a fairly uniform rate. This does not mean, however, that the daily gas production is constant, as a curve of cumulative gas will not show small fluctuations.

Variations in Gas Production.—The curve of daily gas fluctuations suggests the use of a small gas holder to insure a more even supply of gas to the heater. These fluctuations were undoubtedly due to clogging of the gas line by scum during the initial

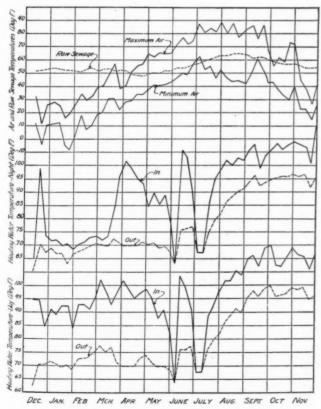


FIG. 8—AIR AND RAW SEWAGE TEMPERATURES.
HEATING WATER TEMPERATURES—NIGHT.
HEATING WATER TEMPERATURES—DAY

stage of digestion, to freezing of condensate in the gas line, and loss of gas around the dome because of loss of liquid through the digester overflow and consequent breaking of the gas seal. These conditions will be corrected by the use of the higher separate seal gas dome shown in figure 4, and by the use of well insulated gas pipe.

The curve showing variations in daily gas production plotted from weekly averages, along with sludge temperature, indicates that the peak of gas production occurred about the middle of March, following a lag and then a period of intense gassification, due to causes explained above. The curve then falls off till about July, after which it increases slightly, and then seems to follow the curve of sludge temperature.

Sludge Temperature.—The temperature curve shows that the digester contents were at a temperature of 52° at the beginning of plant operation. This was raised to 66° in two weeks. The temperature then varied little until July when it rose to 84°, after which it dropped off rather rapidly due to the low temperature.

The abrupt drop in temperature in January was caused by the opening of a valve which allowed some material to drain out of the digester to the clarifier. As this material which was in contact with the raw sewage had to be pumped back, the temperature fell 4°. As heating was discontinued for a week in June when the new gas boiler was installed, the temperature fell slightly at that time.

Up to June it was practically impossible to raise the temperature above 68° because of the low efficiency of the old boiler. The rapid rise in temperature beginning with June 20th was due both to the new boiler and to the high air temperature which cut down radiation losses.

In general, there appears to be no relation between gas production and sludge temperature up to July 15th. This is due, of course, to the initial lag and cumulative effect, as was described before.

Air and Sewage Temperature.—Of the curves of maximum and minimum air and raw sewage (day) temperatures, the first two follow each other very closely and also show a direct relation to sludge temperature. During the first month of operation, temperatures as low as 23° below zero were recorded, with maximum for certain days as low as 4° below zero.

The raw sewage temperature during the day is about 1° to 5° above that at night. The curve shows that the extreme variation is from 47° to 65°. The lowest sewage temperature does not, however, correspond to the lowest air temperatures. This is because there was a larger amount of infiltration at the beginning of April due to the spring thaw.

Temperature of Heating Water.—The curves of ingoing and outcoming heating water during the day and night run parallel to each other and show the number of degrees of heat transferred to the digester material. It will be noted that from December 20th to March 17th there is very little difference between the ingoing and outcoming water temperatures. This is because coal was burned in the boiler between these dates and the coal fire was banked during the night. When gas was burned, the fire was kept going day and night.

The breaks in the curves at the beginning of June

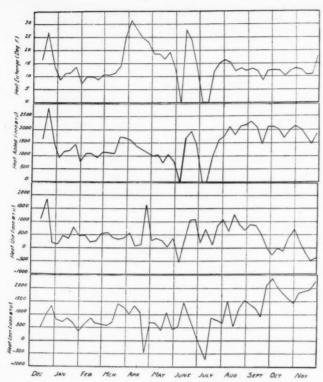


FIG. 9—HEAT EXCHANGE; HEAT ADDED, USED AND LOST

and in July were caused by allowing the fires to go out so that the new boiler could be installed and other changes made in the heating system.

Heat Exchange.—Figure 9 shows heat exchange, i.e. the difference between the ingoing and outcoming heating water for the entire day. In December, when a removal test was run, the coal fire was kept going continuously for a week. After this the curve falls off as the coal fire was kept going only in the daytime. Then, when gas was burned in the old heater both day and night, the curve rose rapidly in March and continued at a high level until the fire was put out in June. This increase in heat exchange was due primarily to the decrease in rate of heating water circulation from about 1700 to 800 cu. ft. per day. After July, with the new heater in service, the heat exchange remained fairly constant but at a lower level than previous to June. corresponds to an increase in heating water circulation from 800 to about 2600 cu. ft. per day.

Heat Added and Used.—The curve of heat added indicates that there was more heat added when the coal fire was burned continuously in December than at any other time. As this fire was then banked at night, the curve falls off sharply and then rises slightly in March when gas was burned continuously under the old boiler. After the new heater was installed there is a rapid rise in the curve due to the higher efficiency of this latter unit.

due to the higher efficiency of this latter unit.

By heat used is meant the B.t.u. required to raise the temperature of the raw sludge pumped each day up to that of the material in the digester, and also the B.t.u. that are utilized in raising the temperature of all the material in the digester.

The curve shows that the heat used during the first two weeks of operation was high because of the

low initial temperature in the digester. The curve then drops off sharply and is fairly constant till in April when there is a sudden increase followed by another sharp drop. Then the curve drops down to a low level which shows a negative value, corresponding to a slight drop in the sludge temperature due to a temporary shutting off of the heating system to allow the installation of the new boiler. The curve then rises rapidly to a fairly high level corresponding to the increase of the sludge temperature from 63° to 84°. In September there is another drop due to the high radiation losses because of the large difference between sludge and outside air temperature. In general this curve follows and is dependent on sludge, raw sewage and air temperature.

Radiation Losses.—Heat loss (i. e. the difference between heat added and heat used) depends upon a number of factors, chief among these being ground, air, sludge and ground water temperature, and also the tank surface area. The curve of heat loss shows that the radiation losses increase with the sludge temperature and are greatest when the difference between sludge and air temperature is greatest. As the digester is in 5 feet of ground water, the temperature of which is about 47° to 50° throughout the year, this curve is not directly dependent on air temperatures throughout the year. The curve shows that the heat loss is fairly constant while the sludge temperature is below 70°. When this temperature was increased, the heat losses increased enormously.

It appears that a sludge temperature of about 66° to 68° can easily be secured and maintained. To raise it above this point is difficult and requires an excessive amount of fuel. An Antigo, where the gas is used only to heat the digester at the present time, it seems best to burn all the gas as it is evolved unless the temperature goes above 85°.

The temperature of the ingoing heating water was never allowed to go above 120°, so that there would be no danger of sludge caking around the heating

SUMMARY AND CONCLUSIONS

Fairly complete records kept over a year's period indicate that the separate digestion of sludge as practiced at this plant gives excellent results.

The gases evolved during digestion are collected and utilized for heating the sludge by means of hot water passing through six coils.

The gas collection and water heating systems are entirely automatic, prevent the circulation of water at too high a temperature, and guard against any danger of an explosion due to back-flashing.

A slow stirring mechanism spreads the incoming raw sludge evenly over the tank area, assists in the removal of digested sludge from the tank, and prevents scum formation.

Piping allows the introduction of raw sludge at either the top or bottom of the digester, and permits the circulation of the sludge from bottom to top of the tank. This is especially valuable in securing an even distribution of lime for pH value adjustment.

Difficulties with gas collection can be avoided by using a high separate seal gas dome, a well insulated gas line and a small gas holder.

The circulation of heating water through the

upper two coils is very poor. A long continuous coil would be preferable.

The pH value of the material in the digester was adjusted by means of lime. Despite the fact that an acid cheese waste was coming into the plant, no further lime additions were found necessary after the first three months.

The digester receives an average of 428 pounds of dry solids per day (72 per cent volatile matter), of which 252 pounds are gassified and 30 pounds liquefied. This gives a reduction in solids of 59%, corresponding to a volatile matter reduction of 75%.

Ripe sludge is produced which appears to be thoroughly digested. Its average solid content is 8.9%, ash 57.5%. The bottom sludge contains 9.5 to 10% solids.

The daily gas production up to August 31st averaged 3560 cu. ft. per day or 0.64 cu. ft. per capita. This corresponds to 11.5 cu. ft. per pound of original volatile matter added and 15.4 cu. ft. per pound of volatile matter destroyed. At the present time the gas is slightly higher.

Except in very warm weather, it is difficult to maintain a sludge temperature higher than about 68° F. To raise it above this temperature requires an excessive amount of fuel.

Since the tank became full the radiation losses have averaged 1,022,000 B.t.u. per day, or 0.6 B.t.u. per pound of sewage added per day.

Assuming an average heat value of 700 B.t.u. per cu. ft. of gas, the efficiency of the Bryant gas boiler was 65.7% over a twenty week period.

ACKNOWLEDGEMENT

The plant was designed by the Jerry Donohue Enginering Co., Sheboygan, Wisconsin. The writers wish to acknowledge the assistance of this company, the Dorr Company, and B. Warner, the plant operator, for assistance and criticisms in this work.

Change in pH of Fresh Sewage Solids

Result of experiments conducted at the Baltimore sewage works. Sludge should enter digestion tanks as fresh as possible

By C. E. Keefer*

Experience with the digestion of sewage sludge during the past sixteen years at the Baltimore sewage-works, interpreted in the light of research work done by Rudolfs, Baity, Fair and others, has indicated that the pH of the material as it is pumped to the sludge tanks has a considerable bearing on the speed of digestion. At the Baltimore plant the chief difficulty with the digestion process has been that it was slow, and thus necessitated a large tank capacity. In former years the sludge remained in the settling tanks for two or three months before it was removed because of the lack of sufficient

*Engineer of Sewage Disposal, Bureau of Sewers, Baltimore, Md.

settling capacity. During the past few years, however, the sludge has been removed about once a week. The pH of this material ranges from 4.9 to 5.1 when it is pumped into the sludge tanks. Because of its acid condition the digestion of it is a slow and difficult process.

Rudolfs¹ has pointed out that the pH of fresh solids usually ranges from 6.3 to 5.9, and drops to about 5.1 within a week. He has also indicated² that the fresher the solids are which are added to digestion tanks the more satisfactory will be the results obtained.

In order to see how closely this first statement corresponds with Baltimore conditions, a small quantity of fresh solids was collected in a pail suspended in the inlet end of the primary settling tanks at the Baltimore sewage-works, and also in the suction chamber of the Eastern Ave. pumping station. Three groups of determinations were made: the first two at the sewage-works on March 28 and Oct. 18, 1927, and the third at the pumping station on Nov. 2, 1927. Immediately after the solids were collected, they were kept in a glass container for 72 hr., at a temperature of about 20° C., and their pH determined colorimetrically at regular intervals. The results are shown in the diagram. In each case the pH of the sewage was 6.8 except that collected on Nov. 2, 1927, which was 6.9. The pH of each sludge sample was 6.8 at the beginning of the observations, and dropped rapidly in each instance during the first 24 hr. until 5.1 was reached in 48 hr. The pH of the solids collected at the pumping station decreased somewhat faster than those obtained at the sewage-works although the sewage is about 4 hr. older at the latter place.

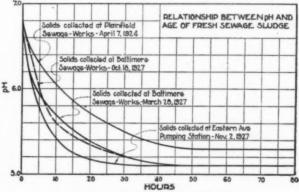
In order to further check these data, three 1-qt. jars were placed near each other in the settling tanks at the sewage-works on four different occasions. The first jar was removed after 24 hr., the second after 48 hr., and the third after 72 hr. In each case the pH was respectively 5.5, 5.3, and 5.1. The pH determined by Rudolfs³ of solids from the Plainfield sewage-works are also shown.

The most important conclusion resulting from a study of the above facts is that solids which are

¹Rudolfs and Fischer, "Ripe Sewage Sludge," Pub. Wks., 57: 171-173.

²W. Rudolfs, "Improving Sewage Sludge Digestion," Pub. Wks., 58: 19-23.

⁸Rudolfs and Lackey, "Digestion of Fresh Solids and Fresh Solids Contaminated With Partially Digested Material," N. J. Agr. Exp. Sta. Bul. 403, and by letter from W. Rudolfs.



RELATION BETWEEN PH AND AGE OF FRESH SLUDGE

deposited in settling tanks should be removed as soon as possible to digestion tanks. Where lime is used to control the reaction, smaller quantities will be needed by following such a procedure. Furthermore, there is less likelihood of the sludge digestion process becoming acid. One of the desirable features of Imhoff tanks is that solids are removed continuously from the settling to the digestion chamber in a fresh condition.

The quick removal of solids from sewage is of such vital importance that plans are being prepared to construct at Baltimore one settling tank, which will be provided with mechanical means for removing the sludge in a fresh condition. If the experience with this unit should justify its installation, additional tanks will be built to treat the entire sewage flow.

C. F. Goob is chief engineer of the Department of Public Works. The sewage-works is under the general supervision of M. J. Ruark, sewage engineer. The writer is in charge of the design and the operation of the sewage-works, and G. K. Armeling is the superintendent.

Sewage Treatment in New York

At present Manhattan Island, New York City, discharges 144,000,000 gallons of sewage per day into the Hudson river through 53 outlets, of which about 28,000,000 gallons, or 20%, passes through fine screens at Dyckman and Canal Streets. A third plant is planned for West 46th Street, which will increase the volume screened by 21,000,000 gallons per day. In the future eight more plants in Manhattan and two in the Bronx will handle the remaining discharge into the Hudson.

Areas equivalent to six city blocks have been made available for screening plants at Sheepshead Bay and Jamaica, and plans for sedimentation and chlorination plants are under way to serve College Point, Bayside, Douglaston, and Little Neck. Plans for a screening plant for Whitestone at Cryders Point are being considered also.

The Wards Island project for treating the sewage of a part of the city was approved last December by the Board of Estimate and Apportionment, conditioned on its being approved by George W. Fuller, who was appointed as consulting sanitary engineer for this purpose.

The Wards Island plant, which is to be located in the East river, will handle the sewage which drains towards that river, and also 135,000,000 gallons per day of the 185,000,000 which is now going to the Harlem river, much of which finds its way into the Hudson.

As developed, the Wards Island project provides for bringing the Manhattan sewage from the area tributary to the East and Harlem rivers between 73rd street and 155th street, now amounting to 94 million gallons per day, and that from the Bronx entering the rivers between West 138th street and East 138th street, now estimated at 61 million gallons per day, to a pumping station on the island, where it will be raised to the treatment plant and the effluent discharged into the East river at Hell Gate

The area now available for the plant will serve this territory for about seventeen years, and as additional areas on Wards Island becomes available, it is planned to extend the interceptors so as to collect from as far North in Manhattan as 190th street and in the Bronx to University Heights and eastwardly in that borough to include East 149th street.

The total areas described will amount to 2,746 acres in Manhattan with a population in 1960 of 760,000 contributing 111,000,000 gallons per day of sewage; and 6,007 acres in the Bronx with a population in 1960 of 1,100,000 and contributing sewage of 161,000,000 gallons per day; or a total of 8,753 acres with a population of 1,860,000 and a sewage of 272,000,000 gallons per day.

It is expected that the interceptors in the Bronx will be built by the president of that borough and the balance of the work, including the two tunnels to the island, the pumping station and the treatment plant, by the president of the Borough of Manhattan.

The cost of completing the first installation, which will provide for a total of 180,000,000 gallons per day of sewage, is as follows: Interceptors in Manhattan, \$7,300,000; in the Bronx, \$2,000,000. Tunnels in Manhattan; \$1,200,000; in the Bronx, \$2,000,000. Pumping and treatment plant, with equipment, \$16,000,000. A total of \$28,500,000.

Operation of Sewage Works*

Report of committee of American Society of Civil Engineers. Inadequate funds and personnel result in neglect of operation and maintenance

During the latter part of 1926 studies were begun by the Committee on Operation and Control of Sewage Works dealing with the underlying principles which it seems necessary to adopt and follow in order to insure the satisfactory operation of sewage works. It was recognized that there were many problems connected with this investigation that were worthy of careful study and consideration. One of the most important of these relates to the most desirable way of obtaining adequate funds to operate sewage works.

FUNDS FOR OPERATION

Frequently, it is easy to awaken interest in the public to such an extent that it is willing to finance the construction of a sewage plant. After the project is completed, however, enthusiasm generally abates, and the plant is often not operated satisfactorily due to the lack of funds. In order to get some idea of the conditions of the sewage works in the United States and especially to learn what proportion are well managed, the Committee communicated with all the State Departments of Health and several municipalities. The investigation showed that by far the major portion of the sewage works are poorly operated. The chief reason for this neglect is that

^{*} Progress report of Committee on Operation and Control of Sewage Works, Sanitary Division, American Society of Civil Engineers. Presented January 19, 1928.

sufficient funds are not appropriated for operation and maintenance. Behind it all, however, is the failure of the public to meet its civic obligations by

taking a real interest in such matters.

Most sewage works that are owned and operated by municipalities and other communities are financed out of general tax levies. Since the keeping of tax rates as low as possible is frequently the aim of those city officials who pass on the amounts to be appropriated for annual budgets, the result is that funds for the efficient operation of sewage works are generally inadequate. In order to correct such a condition it would seem advisable to find some other practicable method of financing sewage works operation. In at least one State such a method has been adopted within the last few years. The Legislature of the State of Ohio has passed a law which permits the Council of any city or village to establish by ordinance equitable rates or charges payable by those who use the sewage works or sewerage sys-As a result a number of cities in Ohio have passed the necessary ordinances with the consequence that what still remains a perplexing problem in most other cities is there being adequately solved. It seems probable that what has worked satisfactorily in several cities may have a much wider field of application. The Committee, therefore, is studying this method of financing the operation of sewage works, and should reach a conclusion in the near

SEWAGE WORKS PERSONNEL

Another question of importance relative to the operation of sewage works pertains to the qualifications and adequate compensation of the personnel employed. Frequently, the superintendents of sewage plants together with their assistants lack the necessary training and experience that are required to meet the demands placed upon them.

Sewage works, which have been built at the expenditure of large sums of money, should be managed by thoroughly trained operators. Moreover, to induce better qualified men to seek such employment, their compensation should be commensurate with their responsibilities. These two interrelated questions of qualifications and compensation are being considered by the Committee.

One undertaking of recent origin, which is now being sponsored by several State Departments of Health and which should be reflected in the more efficient operation of sewage treatment works, relates to the establishing of schools for sewage works operators. The number of States that have adopted this plan is increasing as these schools are beneficial in many ways. They not only promote an exchange of ideas among the employees at sewage plants, but they also afford to those operators having little scientific training an opportunity to become more familiar with the technical phases of sewage treatment. The Committee will study how and by whom these schools should be organized, what field they should cover, and what functions they should perform.

CONTROL ANALYSES

At most sewage works of any size the sewage is sampled and analyzed at various stages in the Operators at different plants treatment process. have adopted routine chemical and biological tests, which serve as a check on the functioning of the treatment units and which are kept as a permanent record for future reference. Not infrequently relatively unimportant analyses are made. Furthermore, there have been no widespread efforts to adopt and make the same routine chemical analyses at different plants so that the sewage and the results obtained can be satisfactorily compared. An examination of this problem is now being made, and the conclusions reached will be presented in a future report of the Committee.

The membership of the committee was: C. E. Keefer, Chairman; W. R. Copeland, A. L. Fales, J. A. Vogleson and F. H. Waring.

Treated Timber Highway Bridges in New Mexico*

Reasons for adopting creosoted timber and piles are chiefly financial. Designs adopted, after two or three years' experience. Timbers framed before being creosoted

Previous to 1925 the experience of the State of New Mexico with treated timber bridges was confined to creosoted piling in a few trestle bridges. Since the beginning of 1925 many creosoted timber bridges have been constructed in New Mexico on Federal Aid Projects. In fact, the total cost of all creosoted timber structures built since that time exceeds one million dollars.

The first bridge built of creosoted material throughout was a trestle over the Rio Grande at

Fort Selden on F. A. P. No. 107-A. It consisted of nine 31-foot spans with 20-foot roadway, the bents having four 45-foot piles per bent. This bridge had no surfacing on the floor and was designed for 10-ton truck loading. The creosoted timber trestle bridges since constructed have been built to provide the following:

1. Clear roadway of 19 feet between felloe

guards.

2. Gravel or crushed rock surfacing six inches thick at center of roadway and four inches thick at felloe guards. These thicknesses are for compacted surfacing.

3. Two fifteen-ton truck loading.

4. Woven wire guard fence attached to steel angle iron rails top and bottom.

^{*}Paper by E. B. Van de Greyn, bridge engineer, New Mexico State Highway Dep't, before Second Annual Highway Conference held under the auspices of the Dep't of Civil Engineering and University of Colorado Extension Division. Illustrations furnished through the courtesy of R. W. Bennett, editor of "New Mexico Highway Journal."



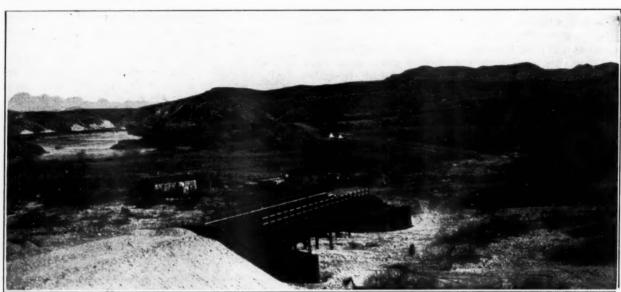
CREOSOTED TIMBER APPROACH TO EXISTING STEEL BRIDGES

5. Laminated or strip floors.

Most of our Federal Aid roads are surfaced with rock or gravel. In maintaining these roads the surfacing on bridges can be taken care of at the same time with the same equipment. between the State and the Bureau of Public Roads, on a basis of about 37% and 63% respectively. The maintenance after construction is borne by the State. Being a comparatively poor state and having a large number of steam crossings, it is therefore evident that in order to make our limited amount of money build as many bridges as possible and also have a low maintenance expense, the creosoted timber bridge was a natural choice.

The chief engineer of the A. T. & S. F. Railway Company informed us that the railroad figured a life of about forty years for its creosoted structures and called attention to

the necessity of cutting and framing all timbers before they were creosoted. Framing of all members before treatment not only insures a better job of preserving, but is probably a saving in cost to both the state and the contractor, as in most cases such framing can be done more cheaply at the creosote works than in the field. A further saving is that of



CREOSOTED TIMBER BRIDGE ON THE CAMINO REAL IN DONA ANA COUNTY

The woven wire guard fence has proved effective. The woven wire and the steel angle rails are painted white.

Cross sectional view of a panel of this type of trestle is shown on Drawing No. 1. This drawing shows also a framed timber bent with concrete base.

The laminated or strip floors are found preferable to plank floors, as there is no springing of individual pieces under truck concentrations as in plank floors.

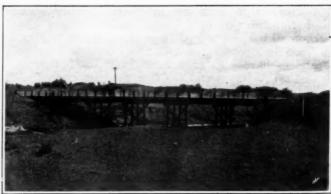
Laminated floors are also employed for our state road bridges. Where asphalt surfacing is used, the strip floor has given the best service. It was found that where asphalt surfacing was used on plank floors, the spring of the planks under truck wheels broke the asphalt at the joints between the planks.

REASONS FOR ADOPTION OF CREOSOTED TIMBER AND PILES

The cost of original construction of our bridges on Federal Aid Projects is divided

creosote oil as well as freight charges on the portions of the members cut away. An average bridge bill will be reduced 2% to 3% in actual board measure due to framing and cutting to exact lengths.

There are many untreated timber trestle bridges



TYPICAL CREOSOTED TIMBER MULTIPLE SPAN BRIDGE

in New Mexico. These trestles, generally built of native pine, soon rot; particularly the piles, which decay at the ground line and at contact surfaces between the wood floor and tops of stringers. Considering the original cost of construction and life of structure, the cost per year of service of the creosoted structure would not be over 40% of the cost of the untreated native timber structure.

Consider, for comparison, the cost of a creosoted timber bridge and an untreated timber bridge consisting of three 21-foot spans, 25-foot piling, and with about a 4 or 5-foot height of backfill at abut-

ments:

The approximate contract price in New Mexico of such a creosoted pile and timber bridge, according to our standard, with 20-foot roadway and designed for 15-ton truck, would be \$3314. The cost of surfacing, woven wire fence and steel angles for fence is not included in this estimate or in the esti-

mate given below for untreated bridge.

The approximate contract price in New Mexico of a similar type bridge of untreated pile and untreated timber would be \$2100. Portions of such a bridge rot out in a few years and need patching after such decay begins. The bridge will need replacing in ten years or less. Some of our untreated timber bridges built in 1921 are so badly rotted as to piles that they now need to be replaced. Considering only the cost of rebuilding the bridge and not taking into considereration the cost of maintenance during the ten years, the average cost per year of the creosoted bridge would be \$82.85, and of the untreated bridge \$210.00.

Another comparison: The original cost of the creosoted bridge would be \$3314, and it would last, say, 40 years. During the 40-year period it would be necessary to rebuild the untreated bridge three times, at a total cost of \$8400, including the original cost. This indicates for the creosoted bridge a saving in 40 years of \$5086.

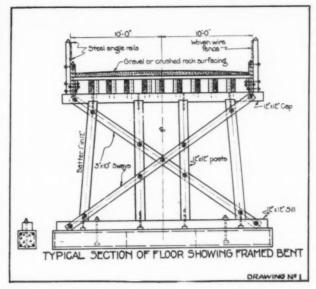
For some of our state and country road bridges, lack of funds prohibits construction of creosoted material throughout. Where possible, in such bridges creosoted piles are used and all contact surfaces of untreated timber are painted with coats of hot creosote oil. Where inadequate funds do not permit the use of creosoted piles, all contact surfaces and the part of the piling most subject to rot are given liberal brush coats of hot creosote.

DESIGN BASIS

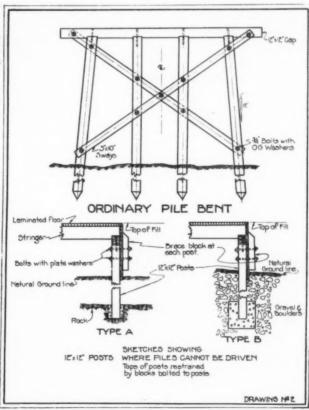
In addition to dead loads, two 15-ton trucks with 80% on rear wheels are used in design of stringers. The gauge of the truck wheels is taken at 6 feet and the distance between axles at 14 feet. No impact is considered.

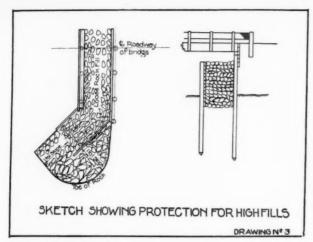
In the design of stringers the bending moments to be taken by interior and outside stringers are determined by the approximate method given in the "Standard Specification for Highway Bridges and Incidental Structures," of the American Association of State Highway Officials. Allowable unit working stresses per square inch for stringers, caps, etc., for our timber trestles follow closely those given in said specification.

In many of our old untreated bridges it was a common thing to find the top of the piling or the posts of abutments pushed in toward the stream by the earth against the bulkhead. In the case of high



fills the piling was not capable of resisting the thrust. The same thing occurred even for fills of ordinary height where posts were set into the ground and backed with bulkhead plank. In the case of posts set into the ground, the depth of burial was not sufficient to enable the posts to furnish a resistance in bending. Therefore, in preparing designs for abutments where piles could not be driven and posts had to be set in gravel and rock, the tops of the posts were braced by a timber block, as shown in Drawing No 2. Sections A and B show the posts set in rock and in gravel. The block back of the bulkhead plank is held by bolts to the posts and plate washers provided. The thrust of earth is carried by these blocks to the ends of the stringers. In this design the stringer is dapped so that shoulder bears directly against the





cap. This close-fitting dap of stringer takes part of the thrust from the block.

Occasionally we have a bridge where the height of fill at the abutments is too great to be taken care of by the ordinary abutment alone. In such cases a protection bulkhead of piling and plank has been placed in front of the regular timber and pile abutment and the space between the two filled with rock. The top of the protection bulkhead and rock fill is carried a little above the highwater level. Drawing No. 3 shows this style of construction. In this construction the stream flow is confined to the space between the two protection bulkheads. If used with a short length of bridge, the protection bulkheads would consume a considerable portion of the waterway, which would be a disadvantage.

CONSTRUCTION FEATURES

The contractor is furnished by the State with several sets of blue prints of detail lists of timbers needed for each bridge. These detail lists give the exact length of each timber and if the timber is a framed timber, the framing number is given. The framing number and the detail of framing for each timber to be framed are shown on our standard drawings.

The contractor furnishes the creosoting company with prints of timber lists and the framing diagrams so that all timber may be cut to length and framed before being creosoted. The State employs an engineer to inspect all materials before (including framing), during, and after treatment at the plant of the company furnishing the creosoted material. This inspector makes a report to the State on each treatment charge of timber or piling. Timber for our creosoted timber bridges is pressure creosoted 12lbs. per cubic foot of wood.

When timber is bored for bolts, the holes are swabbed thoroughly with hot creosote oil. Since all holes are bored to a diameter at least one-sixteenth of an inch less than the diameter of the bolt, and as holes are treated with hot creosote oil, rotting at holes is not considered likely.

Our specifications regarding treatment of pile heads read as follows:

Treatment of Pile Heads: After the necessary cutting has been done to receive the cap, the heads of treated piles shall be given 3 coats of hot creosote oil. They shall then be covered with a coat of hot tar pitch over which shall be placed a sheet of 3-ply roofing felt or galvanized iron, or a covering may be built up of alternate layers of hot tar pitch and loose woven fabric similar to membrane water-

proofing using four layers of pitch and three of fabric. The cover shall measure at least 6 inches more in each dimension than the diameter of the pile and shall be bent down over the pile and the edges fastened with large headed nails or secured by binding with galvanized wire.

Garbage Incineration in New York

During the year 1927, New York City placed in operation a 30-ton Nye incinerator at Great Kills and a 100-ton Decarie incinerator for Jamaica. A Sterling incinerator being built at East 73rd Street, Manhattan, will probably go into commission during the spring of this year. This and the incinerator designed for 215th Street and Ninth Avenue will each have a capacity of 320 tons per day. It is expected that contracts for three 500 ton incinerators in Brooklyn will be let during this year.

Lighting Michigan Highways

Recent additions to lighting some of Michigan's trunk line highways bring the lighted rural highways to a total of 375 miles, most of which is in the so-called Detroit area. It is expected that within the next five or ten years the length of illuminated highways will be greatly increased and will include most of the main thoroughfares across the state.

Street Name Signs*

Result of experiments and investigation to determine the most desirable style and size of letter, color of letter and background, location of sign, and matter placed thereon

"Street name signs are intimately related with the traffic problem. The absence or inadequacy of signs contributes to delay and congestion of pedestrian and vehicular traffic and gives visitors and tourists of any city a bad impression. Clear and understandable signs, which are legible night and day, contribute to the comfort and security of motorists and materially aid those charged with handling traffic.

To determine the most practicable size, style and placement of signs, a series of experiments was carried on in Boston by Adolph J. Post, senior assistant engineer of the Public Works Department, and George H. McCaffrey, then secretary of the Good Government Association of Boston and now acting director of research of the Merchants' Association of New York."

The gentlemen named have prepared a pamphlet which sets forth the results of their investigation and of a questionnaire survey conducted by the Municipal Administration Service by which information was obtained from twenty-four large cities. The above quotation is taken from the foreword of this pamphlet. The experiments described in the pamphlet were in a great degree made possible by and conducted with the cooperation of James H. Sullivan, commissioner of public works of Boston.

In this pamphlet, which is entitled "Street Name Signs," the authors call attention to the fact that "a sign which was legible to the driver of a horse

^{*}Abstract of a pamphlet by Adolph J. Post and George H. McCaffrey, published by the Municipal Administration Service, 261 Broadway, New York City.

approaching a street intersection at a rate of six or eight miles an hour is quite inadequate for an automobilist going at least twice as fast. The ideal sign should inform the modern driver that he is approaching the point where he should turn in ample time for him to regulate his speed, give warning to following traffic and, if possible, get into the most convenient lane of traffic; or should show him that he is not yet approaching that point and need not change his speed or position."

STYLE AND SIZE OF LETTER

Of two signs, that which is more quickly and easily read is the more effective. The experiments referred to were undertaken, taking into account foreshortening, to determine the best style, sizes and proportions of letters, and color of letter and background.

It is found that visability depends upon the least dimension of a letter and it often happens that a tall, narrow letter is less readable than one which is shorter but wider. It would therefore be preferable to sacrifice height rather than width, because there is more foreshortening horizontally than vertically. This would condemn crowding long street names

into a standard length of sign.

In Plate 1, the right hand figures show the effect of foreshortening at 45°. A width of stroke which is one fifth the height of the letter was found to give the most pleasing and most effective relation of the whole to the background. This apparently results because the three horizontal lines and two spaces in a letter like E should be equal to produce the greatest visability, and can be when the width of stroke is in this proportion to the height. Figure 1 uses these proportions, while Figure 2 uses a lighter Figure three shows the disadvantage of condensing or jamming leters together to fit a frame of insufficient length. Figure 4 shows the defect in too heavy a stroke. Figure 5 illustrates at the right the effect obtained at a distance with shaded letters. Figure 6 is an extreme form often used on railroad cars in which foreshortening is offset by original over-expansion.

ADAM Fig. LADAM ADAM Fig. 2 A 1 A M Fig. 5

STYLES OF LETTERS, AND SAME FORESHORT-ENED AT 45 DEGREE ANGLE

The conclusions reached from these experiments were that the best proportioned letters are the block

type in which the letter M is square.

Experiments were then directed at finding the proper size. Three different sizes were used in the first test; three-inch gold letters with the proportions of Figure 1 on a sanded dull black background; the same except that the letters were three and a half inches high; and the third was a sign of blue and white enamel with letters four inches high condensed to fit a standard frame, the letters being of the type of Figure 3, which is known as a New York

These three signs were tested in actual use on a bright day, under similar conditions of light and shade. The method of test was by approach from beyond the range of legibility to determine the point at which legibility began. The actual distances were found to be 208 feet for the first sign, 332 feet for the second and 159 for the third. The first twosigns bore also house numbers 1 and 11/4 inches high respectively, while the third sign bore the name of the cross street in letters 11/4 inches high. These smaller letters were visible at 75 feet, 75 feet and 57 feet respectively.

The results were not entirely convincing as to the best height of letter and another sign was made 40 inches long by 10 inches wide with 3½-inch standard proportion letters for the street name and 2-inch for the house numbers, in gold on a dull black background. The increase in legibility was striking. The street name was easily visible at 350 feet and the house numbers at 100 feet. The observers agreed, however, in recommending four-inch letters for the street names as being even more desirable.

Use of this size and style of letter would seem to require a sign about 10 inches wide and normally 40 inches long. This would indicate the use of wood as preferable to enamelled metal as material for the sign, for an unsupported enamel plate of this size would be in danger of cracking and would be subject to discoloration, rusty edges, chipping and crazing frequently found on enamelled signs which have

been exposed to the weather.

"The fact that the durability of a painted wooden sign is comparable to or superior to that of enamel metal signs may be astonishing to some. comparative data are lacking, it is true, but such observations as have been made indicate that wood has an indefinite life if the surface is protected, while enameled metal signs seem to deteriorate badly in from 5 to 20 years. Instances have been found where gold leaf letters were legible after forty years It is said that wooden signs have been of use.' found whose paint protected letters have been legible for nearly a century.

Of the New York type of enameled metal sign it is said that, while it is attractive in appearance, "it is inferior to properly painted wood in durability, and the glare which is apparently inseparable from its surface greatly reduces legibility under

comparative conditions of light."

COLOR AND TEXTURE

To determine the best color and texture of signs, six signs were made identical in size and shape but in the following combinations of color and texture: A, gold letter on black background of dull smalt texture. B, white letter on blue background of dull smalt texture. C, black letter on orange background of glossy texture. D, white letter on blue background of glossy texture. E, white letter on black background of dull smalt texture. F, black letter on white background of glossy texture.

Five observers compared these signs on a bright clear day and scored them as to visability, durability, appearance and cost. On the score of visability they were arranged in the order of C, A, E. F. B, D. On the basis of durability in the order of A, C, B, D, E, F. On the basis of appearance, A, D, B, F, E, C. On the basis of cost, E, C, F, B, D, A.

The signs were then tested at dusk with only artificial illumination coming from a magnetite arc lamp 150 feet away. In this test B led, followed by E, D, A, and C. As the light continued to fade, white was the only color remaining at all visible. When darkness had fallen, automobile headlights were turned on to the five signs at a distance of 200 feet. The gold and black sign shone out brightly and distinctly while the others appeared to be blotted out. The same result was obtained with the headlights dimmed.

These tests seemed to point to the gold and black sign as the best color combination. The superiority of a reflecting letter against an absorptive background was evident. Any metal letter would give the same effect at first, but gold leaf is superior because it does not tarnish.

The possibility of developing prismatic reflecting letters for use in street signs is being considered, although the cost is considerable. Also experiments are being continued on a pierced sign plate with a prismatic reflecting element behind it which is intended to catch light from a street lamp and reflect it over a considerable street area.

MATTER ON THE SIGN

The usual plan of placing signs with the name of the street along which a vehicle is passing facing this street, while the name of the cross street faces the roadway of that street, was severely condemned as illogical and the result of unquestioned tradition. It is assumed that a person knows the name of the street along which he is traveling and repetition of it is useless. Placing the name of the cross street around the corner is an exasperation rather than an aid to an automobile driver, who has to look backward after crossing the corner in order to read it. Placing the name of the cross street in small letters in an oval above the name of a street is only a slight improvement.

A really efficient sign would tell the driver when he is approaching the street into which he wishes to turn, whether he should turn right or left, and give him this information in ample time for him to regulate his speed, warn following traffic, and, if possible, get into the most convenient lane of traffic for a turn or a stop; or, by informing him that he is not yet approaching his turning or stopping point, permit him to continue without change of speed or position. These objectives can be attained if a properly proportioned sign, bearing the name of the cross street and the numbers within the blocks on either side, is hung in a proper position to be read as the rider or pedestrian approaches an intersec-

tion. Giving the house numbers in the blocks on either side of an intersection is second in importance only to giving the name of the street.

A sign is best seen when near the center of vision. This is possible without becoming an obstruction by placing the sign either just off the roadway at a sufficient height to clear pedestrian traffic, or over the roadway at a sufficient height to clear vehicular traffic. If the sign is hung over the sidewalk from poles placed near the curb, or fastened to the walls of buildings, it is likely to be blanketed or obscured in whole or in part by the building to which it is affixed and by other street signs, poles, awnings, etc.

It is believed that the more effective method is to project it over the roadway like a horizontal semaphore. Data obtained from trucking companies and others as to the higest type of vehicle used in streets and clearing ferry slips, covered bridges, trolley wires and elevated roadways, show that a clear height of 141/2 feet gives a good margin of safety. That this is not too high to be seen clearly is indicated by the fact that present signs in the Borough of Manhattan, New York, are placed 14 feet above the pavement and are readily visible. Actual tests show that they can be read under the visor of an automobile at a distance up to 90 feet without effort and at 34 feet with some slight movement of the There are the additional benefits of greater height that there is more sky reflection from the sign in the day time with consequent better visibility, and the sign can be seen much better over the top of preceding vehicles. It is suggested that traffic signals could be installed on these semaphore signs.

Whatever the position, if there are two street signs on a post, placed at right angles, one is bound to blanket the other in some position. In a large majority of cases the cross street signs is the more important, and therefore the placing of the signs shown in the left hand of the two illustrations, Plate 2, is preferable.

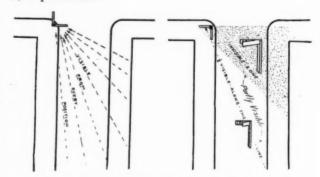


PLATE 2—RECOMMENDED AND CUSTOMARY POSITION OF SIGNS

Specification for the recommended sign are as follows: Sign board ten inches wide, one inch thick, A No. 1 sugar pine. Two prime coatings of white lead sandpapered between coats; all knots shellacked and all cracks puttied. Sizing applied roughly to the shape of the letters. Gold leaf applied to the sized surface. Letters accurately cut in with lampblack ground in oil. (By making the gold leaf larger than the visible letter, extending beneath the black paint, a lap joint is formed and moisture excluded.) While still wet, sprinkle thoroughly with black smalt and shake off excess. Allow to dry away from dust for two days at a temperature of 60° to 80° F.

Scientific Mixing on Kentucky Road*

Use of local aggregates, scientifically proportioned, effected saving of five thousand dollars or more.

By Professor D. V. Terrell[†]

The value of local aggregates in a scientifically designed mix was demonstrated recently on a stretch of Kentucky highway, known as the Owensboro-Stanley Road, 3.126 miles long and 18 feet wide. In building the road, a central proportioning plant consisting of Blaw-Knox bins and batch meters was used. The aggregates were measured in their damp, loose condition. The concrete was mixed in 5-sack batches and given a 1½-minute mixng. The consistency ranged from ½ to 1½ inches slump.

The surface was finished with an Ord finishing machine. No longitudinal float was employed, but light-weight floats with long handles were used behind the finishing machine. The final belting was done with a thin cypress board about 8 inches wide and 10 inches longer than the width of the pavement. The finished surface was immediately covered with damp sheets of burlap and kept wet during the day by sprinkling. The following morning calcium chloride was applied. The pavement was kept closed to traffic for 21 days.

Considerable saving in time and money was effected by this use of local materials in accordance with scientific methods. Samples of the material were furnished by the field engineer and it was required to design a mix using this material. The aggregate did not conform exactly to specifications and it was necessary to set new limits for this special case. The recommendations approved by the State Highway Department and accepted by the contractor follow:

Gravel: Not less than 20 per cent. retained on a 34-inch round screen and not more than 10 per cent. passing a 44-inch round screen.

Sand: At least 20 per cent. to be retained on a number 20 sieve.

In all other respects both coarse and fine aggre-

gate must pass the standard specification.

Construction was started July 29, 1926. The work was continued, using material out of the stock pile from which the original samples were taken. On August 27, new samples were requested by the laboratory and the engineer instructed to make field tests on both sand and gravel to see that it passed the new specifications. The design of the mix fol-

Maximum size of aggregate 1½ inch. Slump 1 inch. Strength 3,000 pounds per square inch.

The ratio of fine aggregate to the sum of the volumes of fine and coarse aggregate measured separately equals "r."

SIEVE ANALYSIS	FOR S	AND AND	GRAVEL	
Percent	Gra	avel	Sa	ind
Retained on	1st	2d	1st	2d
1/2 sieve	0	0	0	0
4	16.9	16.4	0	0
8	66.6	48.6	0	0
No. 4	96.4	97.0	0	0
Vo. 8	97.6	99.6	2.3	3.5
No. 14	98.0	99.7	14.1	17.5
No. 28	100.0	100.0	37.5	39.0
No. 48	100.0	100.0	93.8	88.0
No. 100	100.0	100.0	100.0	100.0
	6.75	6.61	2.48	2.48

 $r = \frac{6.6-5.4}{6.6-2.5} = \frac{1.2}{4.1} = .293$ or 29.3 per cent.

From Figure 13 in "Design and Control of Concrete Mixtures," Portland Cement Association, the real mix is 1:4. Allowing for shrinkage when aggregates are mixed, the volume of sand and gravel measured separately was $4.0 \times 8/7 = 4.6$

The sand = $.293 \times 4.6 = 1.35$ The gravel = $.707 \times 4.6 = 3.25$

Therefore the mix on a dry rodded basis was 1:1.35:3.25. The average bulking of the sand was assumed to be 20 per cent., which then made the mix on a damp sand basis 1:1.62:3.25. The bulking of the coarse aggregate was disregarded and a field mix of 1:1.6:3.2 was recommended. It was realized at the time that this mix was conservative and it was stated that a strength of from 3,000 to 3,500 pounds per square inch could be expected, with a cement factor of 1.75 barrels per cubic yard.

The cylinders made in the laboratory at the time the mix was designed were tested at the end of twenty-eight days and the average strength recorded was 3,550 pounds per square inch.

The same mix was used for two projects, one in Daviess County and the other in Hopkins County. Test cylinders were made in the field on both projects and cores were also drilled and tested.

The results were as follows:

Cylinders Daviess County 22 specimens

Average	age				0	 				 				0				3	1	day	S
Average	slump						 										. 1	.1	in	che	S
Average	strengt	h										3	5:	50)]	b	S.	pe	rs	q. in	n.
Minimum	streng	th						 		 		 31	0	0	11	os	. 1	per	S	q. iı	a.
Maximun	n streng	th		0					 		 	3	75	50	1	b	s.	per	r si	q. ir	1.
	OO per																			-	

Hopkins County

			22	specimer	15	
Average	age .		 			29 days
Average	slump		 			1.12 inches
Average	streng	gth .	 		3500 1bs	s. per sq. in.
Minimum	stren	gth .	 		2745 lbs	s. per sq. in.
					3700 lbs	
					cent. of avera	

CORE DRILLED SPECIMENS

Daviess County

16 cores

Age when																			
Average :	strength							0		0	a	0 1	 	. 5	08.	5	lbs.	per	sq. in.
Minimum	strength			 	 0	0	0		0	0	9	0	 	4	39	0	lbs.	per	sq. in.
Maximum																			

[†]Engineer of Tests, Kentucky State Highway Department. *From "Concrete Highways and Public Improvements."

Hopkins County 16 cores

Age when	tested						90 to	120 days
Average s	trength						5077 lbs.	per sq. in.
Minimum	strengt	h				4	1050 lbs.	per sq. in.
Maximum	streng	th				(5210 lbs.	per sq. in.
88	per ce	ent.	wit	hin	80 per 0	cent. of	average	
Average d	lepth as	sh	ow	n by	cores.		6.0	08 inches

The cement factor as shown by field reports for the Daviess County job was 1.79. The cores, however, showed a sufficient excess thickness which would account for an increased cement factor. The daily field reports showed a cement factor of 1.83 barrels per cubic yard for the Hopkins County job.

SAVING BY USE OF LOCAL COARSE AGGREGATE

For the Daviess County project, three sources of coarse aggregate were available: Ohio river gravel from Louisville, crushed stone from Russellville or Princeton and local gravel from the Ohio river at Owensboro. Sand satisfactory for concrete was also available at Owensboro.

Using the designed mix with the local material, 1,550 cubic yards of gravel were required per mile of pavement. This material was loaded direct from the plant into the batcher. The cost of the gravel at \$1.10 per cubic yard was \$1,705.

Cement factor using standard gravel aggregate
and standard mix
Cement factor using designed mix and local aggre-
gate 1.79
Excess cement per yd. for local aggregate25 bbl
Cost of this extra cement, 1,790 cu. yds.
× .25 × \$2.80=\$1,253.00
From above, gravel = 1,705.00
Total cost of local material\$2,958.00

Had the material been shipped in from Louisville, a total of 1,512 cu. yds. per mile of pavement would have been required.

Cost:

Unloading Freight	1512 cu. yds. @ \$1.35\$2,041. 1512 cu. yds. @ .15	80
Total	\$5,130.	00
	cal material\$2,958.	

If crushed stone had been chosen, a total of 1,628 cubic yards would have been required per mile of pavement.

Cost:				
	1628 cu. yds. @	\$1.08		\$1,758.24
Unloading	1628 cu. yds. @	.15		244.20
Freight	1628 cu. yds. @			
Total				3,956.04
Cement fac	ctor using above	aggregate		1.66
Cement fa	ctor using local	aggregate		1.79
Excess cer	ment using local	aggregate (b	bl. per cu.	.13
COST:				\$651.56
	yds.×.13×\$2.80			
Cost of	gravel	• • • • • • • • • • • •		1,705.00
	of local material of shipped stone			
Net Savin	a of local mate	rial over crus	shed stone	

per mile of pavement......\$1,599.48

An excellent quality of concrete was produced with the local material and the saving effected is a sum worthy of consideration. The results obtained on these two jobs are considered very good. This work is a striking illustration of the value of scientifically designing a mix to give definite results.

Essentials of Good Municipal Reports

Twenty features considered by the author esential to a good report. Promptness, physical make-up, illustrative material and composiiton

Under the title "Appraising Public Reports," Clarence E. Ridley, of the National Institute of Public Administration, publishes an article in "National Public Review" in which he presents twenty points which he considers essentials of a good report.

"In June, 1927," says Mr. Ridley, "the writer was delegated the task of reviewing in these columns some of the typical current municipal reports. Since that time twelve reports have been reviewed. With three exceptions they have been general city reports covering the usual municipal activities. The exceptions were the St. Paul and Richmond reports, which cover only public works activities, and the report of the board of country road commissioners of Wayne County (Detroit, Michigan).

'The twenty points on which the reports were judged, briefly stated, were as follows:

I. DATE OF PUBLICATION

"1. Promptness. The report will have little value unless published soon after the end of the period covered,-six weeks as a maximum.

II. PHYSICAL MAKE-UP.

"2. Size. Convenient for reading and filing, preferably 6" x 9".

"3. Paper and type. Paper should be of a grade and the type of such size and character as to be

easily read.
"4. Important facts. The more important facts should be emphasized by the use of different types of artistic presentation.

'5. Attractiveness. The cover, title, introduction, and general appearance should aim to attract the reader and encourage further examination.

III. CONTENT

A. Illustrative Material

"6. Diagrams and charts. Certain established rules should be followed to insure an accurate and effective presentation.

"7. Maps and pictures. A few well-chosen maps to indicate certain improvements, and a liberal supply of pictures, pertinent to the report, should be in-

"8. Distribution. Great care should be exercised in placing the illustrative material contiguous to the relevant reading material.

B. Composition

"9. Table of contents. A short table of contents in the front of the report is a great aid for ready reference.

"10. Organization chart. An organization chart or table indicating services rendered by each unit, if placed in front of report, will help the reader to a clearer understanding of what follows.

"11. Letter of transmittal. A short letter of transmittal followed by summary of outstanding accomplishments and recommendations for the future should come early in the report.

"12. Recommendations and accomplishment. A comparison of past recommendations with the progress toward their execution will serve as an index to the year's accomplishment.

"13. Length. Fifty pages should be the maximum

length.

"14. Literary style. The text should be clear and concise, reflecting proper attention to grammar, sentence structure, and diction.

"15. Arrangement. The report of the various governmental units should correlate with the organization structure, or follow some other logical arrangement.

"16. Balanced content. The material should show a complete picture, and each activity should occupy space in proportion to its relative importance.

"17. Statistics. Certain statistics must be included, but, wherever appropriate, they should be supplemented by simple diagrams or charts.

18. Comparative data. The present year's accomplishments should be compared with those of previous years, but only with full consideration of all factors involved.

"19. Financial statements. Three or four financial statements should be included showing amount expended and the means of financing each function and organization unit.

"20. Propaganda. It is unethical and poor taste to include material for departmental or personal aggrandizement. Photographs of officials, especially of administrators, do not belong in a public report.

Mr. Ridley then gives a rating of the twelve reports for each of these twenty items, and totaling. obtains values of the individual reports varying from 50% to 74%.

Discussing the several items he said:

"1. Promptness. Only two of the twelve reports were available for distribution within six weeks of the end of the period covered. Five of the twelve reports were not available until six months or more had elapsed. In this rating no credit whatever is given for a report six months or more late, for it is contended that by that time it has lost all of its news value and therefore its usefulness depends alone upon whatever function it may serve as a means of recording financial statistics and historical events,—purposes hardly justified in a report to the taxpayers on the current operation of their municipal government.

"2. Physical make-up. The physical make-up of the reports, on the whole, were quite gratifying. Most of them conformed to the conventional size of 6" x 9". The disappointing feature was the almost complete failure of all the reports to emphasize the important facts. This is very essential, for

few, if any, will read an entire report, so an attempt should be made to emphasize the more important facts, and thus give the hasty reader a definite impression, if possible. The reports were uniformly attractive, varying only in degree.

"3. Illustrative material. A serious error common practically to all the reports was the failure to tell more of the story by charts, pictures, and other illustrative material. Even the effect of well chosen charts and pictures was greatly lessened in some of the reports by poor distribution. In several cases the illustrations were placed entirely outside the relevant

"4. Composition. On the whole, the reports were uniformly good in arrangement, literary style, balance of material, and freedom from propaganda. The conformity to the other essentials under this heading were, however, not so commendable. Some of the letters of transmittal were too long and indefinite, while two of the reports omitted the letter entirely. Only a few of the reports presented a clear-cut and brief statement of important accomplishments and recommendations for future action. Less than one-half of the reports failed to include an organization chart, thereby hindering a ready understanding of the organization units and their relation one to another. Few reports made satisfactory use of comparative data. The financial statements, on the whole, were very unsatisfactory, being either superficial or far too elaborate and en-cumbered with technical accounting terms. Far too many statistics unsupplemented by charts characterized most of the reports. A table of contents appeared in but three of the reports, while some of the others attempted to substitute for it an exhaustive index in the back of the report. Exceeding all the other violations of the essentials herein presented was the length of the reports. Only four of the twelve reports came under fifty pages; five were in excess of 100 pages, and three exceeded 150 pages.

"Briefly, the chief defect in public reports, as exemplified by those appraised herein, is an overestimation of the capacity and willingness of the average taxpayer to consume such material. There has been, however, a very marked improvement in public report writing in recent years, and the type of reports now coming to this office augurs well for the future.

Torresdale Pumping Equipment

About 60% of the water consumption of Philadelphia, which averages 375,000,000 gallons per day with peak loads of 500,000,000 gallons, comes from the Delaware river which is pumped by the Torresdale plant. The original plant was built twentyfive years ago with seven 40,000,000-gallon steamdriven centrifugal pumps. These were replaced six years ago by new engines using the same pumps. "These engines were never satisfactory for this purpose, being continually out of service mechanically due to repairs and on account of high steam consumption," says Samuel H. Thompson, superintendent of pumping stations at Philadelphia, "placing such load on our boiler plant that it was a continual drain upon our resources to keep both ends in operation. Two years ago it was decided to revamp the

entire plant with new pumping equipment," and motor-driven centrifugal pumps were chosen as best fitted for the needs for fifty years to come. Six 50,000,000-gallon pumps were asked for, which would give ample supply and reserve for the next generation. Contract for these was awarded to Fairbanks, Morse & Company. Due to the fact that the condition was possitively unsafe and dangerous, the plant was installed in record breaking time.

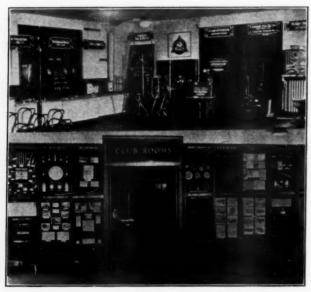
The new plant consists of 36-inch centrifugal pumps direct driven by 600 h. p. Fairbanks-Morse motors. When tested, they delivered an average of 56,000,000 gallons per 24 hours.

Mr. Thompson says that these "machines have now been running for the past eighteen months with no trouble whatever except minor adjustments. The present station is probably the largest low-head station in the United States, delivering daily over 200,000,000 gallons. . . . This station, which formerly operated with a total of 70 men, now operates with two men on each shift of eight hours."

Exhibit at Engineering Society Headquarters

The Cleveland (Ohio) Engineering Society, a little over a year ago began the installation at its headquarters of an exhibit of engineering equipment and materials. This affords an unusual opportunity for presenting products to the Cleveland engineering market and has been utilized by so many manufacturers and dealers that more space is being added to the headquarters to permit expansion of the exhibit.

The exhibit is arranged around the sides of a large meeting room, used for meetings not only of the Cleveland Engineering Society but of such organizations as the Production Managers Group of the American Plan Association, and local Sections of American Chemical Society, American Institute of Mining & Metallurgical Engineers, American Society of Civil Engineers, American Society of Heating & Ventilating Engineers, American Society



EXHIBITS AT ROCHESTER ENGINEERING SOCIETY'S CLUB ROOM

of Mechanical Engineers, American Society for Steel Treating, American Welding Society and Society of Automotive Engineers, the total attendance runing from 500 to 1000 technical men and industrial executives per month.

When alterations have been completed, the meeting room will have a capacity for over 300 persons, in addition to some 1800 square feet of display space around the sides of the room. Displays are placed on the floor or arranged on tables of standard design, or in glass covered, illuminated display panels on the walls, giving the room a uniform and attractive appearance. Those who visit the rooms consider the displays a very valuable educational feature, giving them an excellent opportunity to learn about new products available for their use.

Liability for Water-Borne Typhoid

Legal liability of private and municipal corporations for deaths and sickness caused by polluted water furnished by

By James A. Tobey, LL.B., Dr. P.H.*

Since 1910 damages amounting to considerably more than \$50,000 have been awarded in court actions against corporations for injuries and deaths due to typhoid fever caused by polluted water supplied by these corporations to individuals. During this period there have been at least 40 authentic outbreaks of typhoid, dysentery or intestinal disorders attributed to ground water supplies, and as a consequence there has undoubtedly been paid in settlements out of court many times the amount granted by juries for such injuries. There is on record, in fact, one payment of \$110,000 by a steamship company to numerous persons who contracted typhoid from water furnished on a steamship.

It is an expensive proposition for a corporation to be careless or negligent in supplying such an important commodity as water, and it ought to be. Typhoid fever, spread as the result of polluted water, is a legal wrong. Since it is an accepted legal maxim that for every wrong there must be a right, the party responsible for the disease can be and should be liable for the damage done.

This proposition has come before the courts of last resort in the United States on numerous occasions during the past forty years. As the result of decisions in eight states up to 1927, it is now the settled law in this country that an individual or corporation which supplies water for human consumption must exercise every reasonable effort to ascertain the quality of the water and to take every possible precaution to render it safe. While not a guarantor of the purity of the water under the doctrine of implied warranty, the corporation which supplies it is liable for negligence in failing to exer-

^{*} Fellow. American Public Health Association.

cise reasonable care in apprehending danger and

taking the necessary steps to avert it.3

This legal doctrine applies not only to individuals and private corporations who distribute water for profit, but also to municipal corporations, which supply water either for convenience or profit. Municipal corporations are exempt for injuries caused in the course of their governmental duties, but they are liable for those resulting from their private or corporate functions. The operation of a waterworks and the furnishing of water to its citizens is a commercial function and thus is not a governmental, This has been the rule but a corporate, activity. of law ever since it was first laid down in 1910 in a Minnesota case,4 in which \$5,000 damages are said to have been awarded against a city because of a death occasioned by its negligence in allowing its waterworks to become polluted with typhoid. In this notable decision, the court said:

It is obvious that a sound public policy holds a city to a high degree of faithfulness in providing an adequate supply of pure water. Nor does it appear why the citizens should be deprived of the stimulating effects of the fear of liability on the energy and care of its officials; nor why a city should be exempt from liability while a private corporation under the same circumstances should be held responsible for its conduct and made to contribute to the innocent persons it may have damaged.

Not only may the municipality be liable for typhoid due to its water, but those officials charged with the supervision and operation of the water supply may, under certain conditions also be liable.⁵ A municipal officer is not responsible for honest mistakes in judgment, but he is liable for gross and culpable negligence which results in serious injury. Persons who have suffered as the result of such neglect have usually elected to recover from the municipality, whose agents are at fault, rather from the officials or employees themselves. A judgment against a city is more easily collected than one against a more or less poorly paid public servant who may have been discharged or removed because of his negligence.

Although it is the legal duty of a corporation or other agency supplying water to furnish its consumers with a pure and whoesome supply, it is a question of fact in each case as to whether this has been done. The rule of law is unvarying, but the circumstances determine whether or not the rule is applicable. In order to recover, the burden rests on the aggrieved party, as plantiff, to establish by a preponderance of the evidence these three propo-

sitions:—

First that the typhoid fever was actually contracted from the water furnished.

Second, that the person or corporation supplying the water was guilty of negligence in allowing or failing to prevent the contamination.

Third, that the injured party himself has exercised due care and was not guilty of contributory

negligence.

Now let us see what facts have been determined to constitute negligence sufficient for a recovery. In recent years the courts have been more strict in this regard. Back in 1890, for instance, typhoid was apparently caused by drinking water from a city well. Since there was no definite evidence to show that the typhoid was caused by any defect in the

well, recovery from the city was not allowed.⁶ So, too, no damages were allowed against two private water companies in Pennsylvania, because, though typhoid had come from drinking the water, no actual

negligence could be proven.7

Where a death from typhoid was caused by drinking polluted water supplied by a private company, but it was a matter of common knowledge that this water was contaminated, a fact well known to the deceased who, nevertheless, deliberately used it, no recovery was allowed. This case recognized the fact that a water company owes a duty of disclosing any danger in its supply and is liable for failure to do so, as well as for neglect in endeavoring to make the water safe. Not being an absolute guarantor, and in view of the exceptional circumstances clearly showing gross contributory negligence, no damages could be allowed here. Later decisions which do permit recovery have distinguished between the facts in this case and in their own.

From 1910 on, beginning with the Minnesota case of Keever v. Mankato, already cited, there has been a line of decisions in which damages have been allowed against municipal or private corporations because of typhoid caused by pollution of the water. Even before that year, moreover, there were decisions relative to the contamination of water. Thus, in 1896 it was held in Pennsylvania that a water company which supplies impure water causing typhoid can be enjoined from collecting water rents. Later in this same state an injunction was issued to require a water company to supply a sufficient quantity of pure water free from typhoid. Later in the same state an injunction was issued to require a water company to supply a sufficient quantity of pure water free from typhoid.

In a famous New Jersey equity decision of nearly 100 printed pages,¹¹ it was held by the court after much discussion of the possibility of typhoid, that a city water supply contract which declares the water to be furnished must be pure and wholesome for drinking and domestic purposes is not complied with when the works may be effective to prevent contamination during only part of the year, and ineffective at other times.

Several years later it was decided in this same state in another case¹² that a water company is bound to furnish water fit for drinking and the negligent supplying of water deleterious to health gave a cause of action to a consumer injured thereby. "Water," said the court "is a necessity of life, and one who undertakes to trade in it and supply customers stands in no different position to those with whom he deals than does a dealer in foodstuffs. He is bound to use reasonable care that whatever is supplied for food or drink shall be ordinarily and reasonably pure and wholesome." In this case \$750 damages were awarded for the illness of three children from typhoid.

Decisions in Pennsylvania¹³ and Connecticut¹⁴ in 1914 had held that private water companies are legally obligated to adopt approved precautionary measures to protect the community from the risk of infection and that it is a question of fact for the jury as to whether they had done so. In the former case approximately \$1,500 was allowed for the death of a child. At a time of low water the company had taken its water directly from a sewage polluted river and as the only other food consumed by the baby was condensed milk, which was shown to be

A leading decision on the subject of typhoid liability was handed down in 1917 in Maine. 15 In its opinion the court reviewed the law at length, referring to the Hayes v. Torrington and Jones v. Mt. Holly cases cited above. Here \$1,500 damages were awarded because of a non-fatal illness from typhoid due to contaminated water. It was

pure, this water was held to blame for its death.

shown that typhoid was in fact attributable to the water and that the company had been negligent-In disposing of the contention that the plaintiff had been guilty of contributory negligence, the court said: "It is no part of the duty of the consumer to investigate the water supply and ascertain possible sources of pollution. That duty rests on the water company, together with the further duty of taking such positive action as is necessary for the

protection of its customers.

Although it was decided in New York in 1920 that there is no liability for typhoid due to a city water supply purely on the grounds of an implied warranty,16 negligence was held to be ample reason for allowing such damages in a case in 1919.17 Through negligence a badly contaminated water supply intended only for fire prevention was permitted by the city to get into the supply intended for drinking purposes., As a consequence the plaintiff contracted typhoid and was awarded judgment for his injuries. On appeal it was held that the facts were for the jury to determine and a verdict resting on them should be upheld. Recently damages were awarded by a lower court against the City of Albany for typhoid caused by its water, but this decision has been appealed and has not yet been finally settled.

The most recent of the cases with reference to the liability for typhoid have occurred in the State of Washington. 18 In one of these, \$6,000 damages were granted against a city because of the death of a husband and father from typhoid contracted from the city water, and these damages were held on appeal not to be excessive. In this case polluted water was carelessly permitted to enter the city's water through a by-pass from an industrial plant. In a later case¹⁹ decided in this state, the rule of law that a corporation is liable for negligence in supplying water was reaffirmed, but the evidence in the particular case was not sufficient to prove that the plaintiff actually contracted his typhoid from

The review of the score or so of court decisions on the liability for typhoid is convincing proof of the principle that, entirely apart from the humanitarian aspects involved, it is poor business for a corporation of any kind to neglect such an important matter as the safeguarding of the water it dispenses. This sound legal and commercial principle is further fortified by the experience of factories and other industrial concerns which furnish drinking water to their employees. Suits for damages for typhoid from this cause have been before the courts on at least ten occasions in eight states, usually in connection with workingmen's compensation laws.
Since 1915 the highest courts of Wisconsin,

Indiana, Michigan, Illinois and California, and a Federal court in an Oregon case have held that typhoid fever due to drinking water furnished by an

employer is an accident and that compensation must be paid.20 Only in Ohio and Texas has the opposite view been taken.21

Any corporation in the water business will, as a consequence of the law of liability regarding typhoid, find it a good investment to employ adequate methods to protect the purity of the water, as by proper filtration and sterilization. The first cost and operating expenses of chlorination or other effective sterilization are certain to be less than the damages which are likely to be awarded for sickness due to a carelessly polluted water supply.

The law has recognized that water is too precious a commodity to be handled carelessly. In this respect the law has kept abreast of scientific progress in public health. This is as it should be, for the protection and promotion of the health of the people demands that those charged with the responsibility of making available a necessary commodity for human consumption must see to it that adequate measures are taken to insure its safety. For negligence in this respect the corporation has been and should be made to pay the price of its folly.

¹Report of Committee on Sanitary Control in the Development of Ground-Water Supplies. Trans. Sixth Ann. Conf. State Sanitary Engineers (1925). P. H. Bulletin No. 160, U. S. Public Health Service, Washington, D. C.

"Mendelsohn, I. W.: Responsibility of Interstate Common Carriers in Supplying Safe Drinking Water to Passengers and Crew, U. S. Public Health Reports, April 1, 1927.

"Hamilton v. Madison Water o. (1917), 116 Me. 157,100 Atl. 659, Ann. Cas. 1918 D. 853.

4Keever v. Mankato (1910), 113 Minn. 55, 129 N.W. 158, 33 L. R. A. (N. S.) 339, Ann. Cas. 192 A 216.

"See Tohey, J. A.: Public Health Law. (1926). Williams & Wilkins, Baltimore, Md.

"Danaher v. Brooklyn (1890), 119 N. Y. 241, 23 N. E. 745, 7 L. R. A. 592.

"Buckingham v. Plymouth Water Co. (1891), 142 Pa. St. 221, 21

Wilkins, Baltimore, Md.

*Danaher v. Brooklyn (1890), 119 N. Y. 241, 23 N. E. 745, 7
L. R. A. 592.

*Buckingham v. Plymouth Water Co. (1891), 142 Pa. St. 221, 21
Atl. 824. Gosser v. Ohio Valley Water Co. (1914), 244 Pa. St. 59.

*Green v. Ashland Water Co. (1898), 101 Wis. 258, 77 N. W. 722,
43 L. R. A. 117, 70 Am. S. R. 911.

*Brymer v. Butler Co. (1896), 172 Pa. St. 489.

*Peffer v. Penn. Water Co. (1908), 221 Pa. St. 578, 70 Atl. 870.

*Ilersey City v. Flynn (1968), 74 N. J. Eq. 104, 70 Atl. 497.

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*Ilersey City v. Torrington Water Co. (1914), 58 Pa. Sup. Ct. 63.

*Ilersey V. Torrington Water Co. (1917), 116 Me. 157, 100 Atl. 466, 40 N. E. 882, 13 A. L. R. 1123.

*ISCanavan v. City of Mechanicsville (1920), 229 N. Y. 473, 128

N. E. 882, 13 A. L. R. 1123.

*ISTabbs v. City of Rochester (1919), 226 N. Y. 516, 124 N. E. 137, 5 A. L. R. 1396.

*IsAronson v. City of Everett (Wash. 1925), 239 Pac. 1011.

Roscoe v. City of Everett (Wash. 1925), 239 Pac. 831.

*IWebber v. Pac. Power & Light Co. (Wash. 1926), 242 Pac. 1104.

*Evennen v. New Dells Lumber Co. (1915), 161 Wis. 370, 154 N. W. 640, L. R. A. 1916 A. 273, Ann. Cas. 1918 E. 293.

Aetna Ins. Co. v. Portland Gas. Co. (1916), 229 Fed. 552, 144

C. C. A. 12. L. R. A. 1916 D. 1027.

Wasmuth-Endicott v. Karst (Ind. 1922), 133 N. E. 609.

Frankamp v. Fordney Hotel (Mich. 1923), 193 N. W. 204.

Ames v. Lake Independence Lumber Co. (Mich. 1924), 197 N. W. 499.

Christ v. Pac. Mut. Life Ins. Co. (1924), 312 III, 525, 144 N. E.

Christ v. Pac. Mut. Life Ins. Co. (1924), 312 Ill. 525, 144 N. E.

ol. Rissman v. Ind. Comm. (1927), 323 Ill. 459. Fidelity and Casualty Co. v. Ind. Accid. Comm. (Cal. 1927), 258

Pac. 698.

²¹Ind. Comm. v. Cross (1922), 104 Oh. St. 561, 136 N. E. 283.

Buchanan v. Md. Casualty Co. (Tex. 1926), 288 S. W. 116

Sewage Pumping at Atlantic City

The sewerage system of Atlantic City is privately owned by the Atlantic City Sewage Company, which was granted a franchise about fourty-two years ago. The average flow of sewage is 11,000,000 per 24 hours in winter and 25,000,000 gallons in summer. The sewage flows by gravity to a sump in the pumping station, which is located in the heart of the city, and is then pumped through a two-mile pipe line against a total head of 35 feet, to a disposal plant where it is chemically treated and the effluent discharged into a creek.

The pumping plant originally was equipped with a small Corliss engine. Other pumps were added at intervals, and by January, 1927, the plant was using two 6-inch sewage pumps direct connected to motors, and one 12-inch, one 14-inch, one 15-inch and one 16-inch pump, all belted to electric motors. The old steam plant was retained for standby purposes. The rate of power purchased to operate these motors was 1.9 cents per k. w. h., including the demand charge, and the cost per million gallons of sewage pumped was \$4.85.

In the early part of 1927 the sewage company decided to install a new standby unit in place of the old steam engine. They selected for this purpose a 240 h. p. F-M Diesel, direct connected to a 20-inch sewage pump of the Wood type. This unit was operated more than 1000 hours last year, and pumped 615,000,000 gallons at a total cost for fuel and lubricating oil of \$801.52, or \$1.30 per million gallons pumped.

E. C. Eyre is the superintendent of the plant, and

Robert Homestead is chief engineer.

Treatment of Slaughterhouse Waste in Holland¹

By surface aeration activated sludge plant. Great reduction in volatile matter. oxygen consumed and alkalinity and considerable formation of nitrates. Plant very flexible and of low cost for construction and operating current.

By Willem Rudolfs² and H. Kessener³

SURFACE AERATION.

As is well known, surface aeration versus compressed air application from the bottom has been studied for several years in Europe. We have only to mention Haworth's paddlewheels and the spiro-flow or so-called Bolton tanks. The junior author, director of the government institution for purification of waste waters at the Hague, Holland, has for several years conducted experiments with surface aeration processes and has now a small plant built and in operation at Apeldoorm, Holland, where slaughterhouse waste is treated by surface aeration. Several other plants are in process of construction at Hilversum, Breda, Holten, Coevorden, Holland, and at the sea resort, Knocke, Belgium.

The principle of surface aeration takes cognizance of the fact that, in the processes of activated sludge, whether they be purely biological, purely chemical, or a combination of the two, the absorbed rather than the free oxygen is utilized. Most of the compressed air supplied for activation is used to keep the organic solids in suspension. Assuming that the activated process is a combination of biological and chemical agents, the organic substances are decomposed by these bio-oxidation processes, whereby the carbon is changed partly to CO2 and partly again utilized to build up living organic material. It is even possible that during the first hours of aeration all the carbon is utilized for the growth and multiplication of micro-organisms.

Under the influence of prolonged aeration, nitrogenous substances and sulfur compounds do not produce as end products NH3, H2S and mercaptans, but NO2, NO3, and SO4. During the first few hours of aeration the type and number or organisms present change; simultaneously reassimilation of carbon and clarification of the sewage takes place. Experiments conducted in New Jersey show that under-aerated sewage

solids settle out rapidly, giving good clarification. Parsons and Wilson4 came to the conclusion that the activated sludge process should be separated into stages in order to secure more efficient operation of each stage. Surface aeration is, on account of ease of manipulation and low cost, particularly adapted to such a separation of stages, although good results can be obtained with the process in one tank.

DESCRIPTION OF PLANT.

The slaughterhouse waste treatment plant at Apeldoorm is a surface aeration activated sludge plant which consists of a bar screen, grease catcher, aeration tank, sedimentation chamber, a nearly flat-bottomed septic or digestion tank, grease pit and sludge pit. The plant is small and designed for the treatment of 30,400 gal., which is received during eight working hours daily, except Sundays. A still more difficult situation will be encountered at Hilversum, where a mixture of sanitary sewage, wool waste, dye waste, etc., is to be treated with a flow varying from 130,000 to 660,000 gallons daily.

Figure 1 shows the plan and cross-sections of the plant. The dimensions of the plant and its different units are given in Table 1. For convenience sake, the measurements in centimeters have been converted into feet and inches, but the latter figures are not exact. The general layout is well shown in figure 2, a photograph taken just before the plant was put into opera-

Table I-Dimensions of the Apeldoorm Plant

	Length	Width	Depth
Plant over-all	55'.3"	23'.0"	
Aeration tank	37'.0"	9'.9"	12'.3"
Digestion tanks	39'.4"	6'.10"	12'.3"
Settling tank	9'.9"	7'.4"	14'.9"
Grease catcher	9'.9"	7'.4"	
Grease pit	7'.4"	3'.9"	12'.3"
Sludge pit	32'.0"	3'.9"	12'.3"

The incoming waste is kept in suspension by wooden racks or paddles (fig. 3) which turn diag-

¹Paper No. 63, Department of Sewage Disposal, N. J. Agricultural Experiment Station, New Brunswick, N. J.
²Chief, N. J. Sewage Experiment Station.

^aDirector, Bureau Waste Purification, Holland.

⁴Surveyor, Sept. 9, 1927, pp. 221.

onally to the incoming sewage, but with the current produced by the aeration device (fig. 1). The surface aeration device consists of ordinary street cleaning brushes, nine feet long, four in a row which are from ½ to ½ inch submerged in the liquid. The paddles are totally submerged. Figure 4 shows the brushes and paddles in place. The shaft of the paddles makes 3¾ revolutions per minute, while the brushes made 57 revolutions per minute. The speed of rotation may be changed conveniently at will. The brushes cause an even rippled flow and the amount of air beaten

Table II—Slaughterhouse Waste Treatment at Apeldoorm RESULTS OF SAMPLES TAKEN OCTOBER 19, 1927.

	Influent1	Effluent ²	Reduc.
	p.p.m.	p.p.m.	%
Total solids	. 1982	418	78.9
Volatile mater	. 1668	162	90.3
NH _s -N		6.9	77.6
AlbN	. 23.1	1.8	92.2
Total N		21.1	90.7
3-min. test		0.6	99.3
3-min. after 5 days at room temp	. 84.2	1.3	98.9
4-hr. test		5.4	98.9
KMnO ₄ number ³		13.1	98.7
Alkalinity (CaO)		51.7	71.1
Cl		62.9	9.5
NO2-N		0.7	
NO ₃ -N		25.4	

Relative stability—no discoloration after 4 days at 27°C.

1—Influent: blood red; stench, free of floating matter.

2—Effluent: colorless, odorless, clear.

3—10 min. boiling in acid medium.

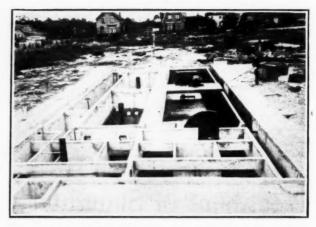


FIG. 2-GENERAL LAYOUT OF APELDOORM PLANT

into the waste is considerable, due to the numerous interstices between the fibrous brush hairs. Figure 5 shows the brushes in actual operation creating a white foam of air bubbles in the waste. The aeration tank is only 9 feet wide, but the one which is under construction at Hilversum is 16 feet wide. There are a number of different features in the Hilversum and other plants which will be described later.

PESIILTS

During the months of October and December, 1927, a number of tests were made at the plant

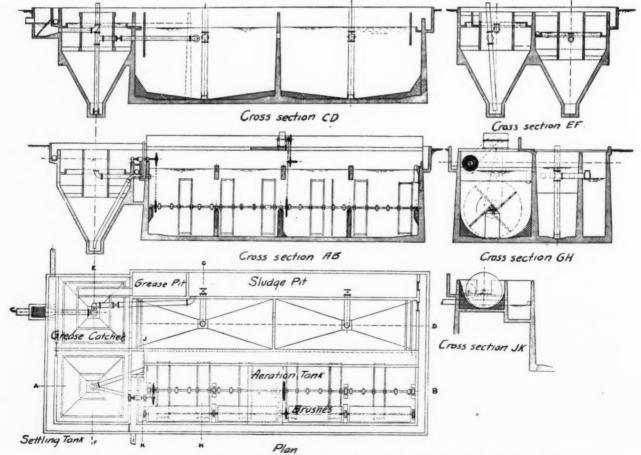


FIG. 1-PLAN AND SECTIONS OF SLAUGHTERHOUSE WASTE TREATMENT PLANT AT APELDOORM

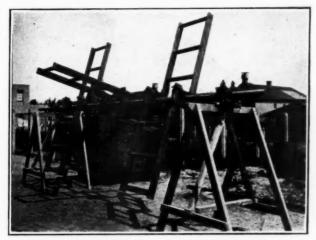


FIG. 3-CONSTRUCTION OF STIRRING PADDLES

dealing with the strength and composition of the material treated and with the performance of the system. Table 2 gives a typical example of the strength of the sewage, the amounts of the different constituents and the percentage reduction.

The strength of the waste is considerable; this

The average reduction figures for the solids and nitrogen compounds show partly what happened. It must be borne in mind that the influent is always blood colored, has the disagreeable stench connected with such waste, and was, except in one instance, free for suspended matter. The effluent was colorless, odorless and clear.

It is of interest to note the reduction in total alkalinity and chlorides. Ordinarily sodium chloride in solution would not be affected by aeration. We may assume therefore that the chlorides adhere in this instance to the floc formed and settles out with the sludge. The alkalinity, expressed in terms of CaO with methyl-orange as indicator, was reduced 68 per cent on an average. A comparison of this reduction in alkalinity (in terms of CaCO₃) with some results for activated sludge plans in America is of interest. The American results are taken from Publ. Health Bull. 132.

	Infl.	Effl.	% red.
Houston (south)	304	220	27.5
Houston (north)	270	198	26.5
San Marcos	311	239	23.0
Sherman	515	416	19.5
Apeldoorm	330	105	68.0

Table III-Slaughterhouse Waste Treatment at Apeldoorm RESULTS FOR PERIOD OCTOBER DECEMBER, 1927

		-Influent-			-Effluent-		Ave
	Min.	Max.	Av.	Min.	Max.	Av.	Rec
	ppm.	ppm.	ppm.	ppm.	ppm.	ppm.	%
Total solids	1566	1992	1637	306	504	421	74
7ol. matter	1274	1684	1350	162	244	190	86
IH ₂ -N	12.8	83.7	35.6	0.5	19.6	8.6	75
1bN	15.7	30.8	21.9	0.5	1.8	1.2	94
Cotal N	92.1	228.6	200.0	12.0	28.8	18.9	91.
-min. test	32.3	84.2	65.7	0.3	3.5	1.6	97
min. after 5 da. at room tem				0.3	3.2	1.3	98
-hr. test	127.0	514.2	262.3	1.3	10.4	5.5	97
MnO4 number	384.3	1010.9	829.7	13.1	22.1	15.4	98.
lk. (CaO)	120.5	287.0	210.0	36.2	103.2	67.1	68.
1	55.3	90.8	69.0	57.1	71.3	62.0	10
O ₂ -N	0	0	0	0.1	6.7	1.4	
O ₂ -N	0	0	0	13.4	45.7	24.5	

is especially to be seen from the volatile content, which amounts to nearly 85 per cent. of the total solids. Variations in the different components of the waste are rather small, as can be seen from Table 3, showing the minimum, maximum and

Whatever significance may be attached to the reduction in alkalinity, it must be remembered that the American activated sludge plants given for comparison treated mainly domestic sewage. The reduction in alkalinity in connection with average of all samples taken. the reduction in oxygen consumed gives addi-

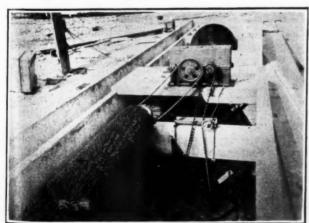


FIG. 4-BRUSHES AND PADDLES IN PLACE

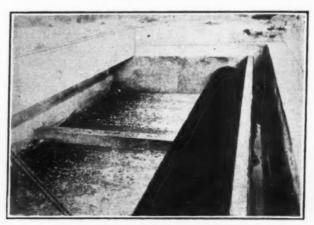


FIG. 5-BRUSHES IN OPERATION

tional evidence of the degree of purification accomplished. The permanganate method of oxygen consumed measures roughly the carbonaceous portion of polluting material. According to Johnson⁵ this method yields only one-fifth of the results obtained biologically. This may account for the comparatively low O₂ consumed figures obtained, considering the type and strength of the waste. This waste contains large quantities of nitrogenous substances which would not be measured by this test. The results for ammonia,

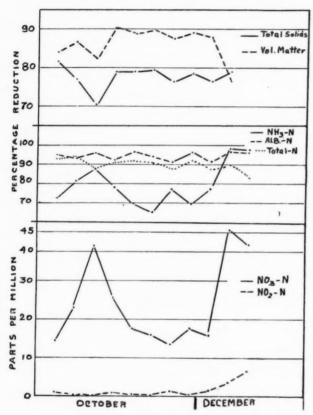


FIG. 6—RESULTS OBTAINED AT APELDOORM PLANT

albuminoid nitrogen and total nitrogen reduction are, therefore, far more important. The increase in nitrates accomplished by this scheme of aeration is, perhaps, the most significant. The aeration was sufficient to produce nitrates varying from 13.4 to 45.7 p.p.m. with an average of all samples of 24.5 p.p.m.

The most important results obtained are graphically shown in Figure 6. The percentage reduction of volatile matter is remarkably constant; the same is true for the albuminoid and total nitrogen reduction. Attention is called to the direct relation between percentage ammonia reduction and nitrates formed.

COST.

The whole installation is inexpensive. The wooden paddles can be made at low cost. The street brushes used cost in Holland about \$5.00 apiece, while the other accessories, including motor, are comparatively inexpensive.

The power used to drive the brushes at 57 revolutions per minute and the submerged shaft

The system has great flexibility, because for stronger sewages the aeration can be increased by simply dipping the brushes somewhat deeper into the liquid. It is interesting to note that the December results were obtained with unusually cold weather for Holland, namely with tempera-

DIGESTION

tures of 15 to 18 degrees F.

The settled sludge will be digested in the nearly flat-bottomed tank alongside the aeration tank. It has been demonstrated by one of us and others that activated sludge can readily be digested under the proper conditions, and no troubles are anticipated from this source.

Placing Concrete with Portable Conveyor

In paving and walling a channel in connection with flood control work in Los Angeles County, California, the contractor, the Roche Axman Company, mixed the concrete in a 27E paver, and used this for laying the floor in a channel 3,400 feet long and 47½ feet wide, as in laying a concrete road pavement. As this work progressed, reinforcement was placed and forms set in position for the 8-foot perpendicular side walls. After the floor had been finished, a portable conveyor was hooked up to the paver and a large hopper was installed at the lower end of the conveyor. The concete from the mixer was discharged directly into the hopper and by it conveyed and discharged directly into the wall form. The concrete was mixed with a 6-inch slump. Approximately 45 tons of concrete was poured per hour using these two pieces of equipment. The conveyor was trailed by the paver in changing position.

State Forces to Maintain Colorado Highways

Beginning with February 1 of this year, the State Highway Department of Colorado took over all maintenance and reconstruction work on federal aid highway systems in Colorado. Heretofore all maintenance and reconstruction work on federal aid and state roads has been done by county forces, cooperating with the State Highway Department, the latter paying one-half the expense. In 1927 the expenditures of the state and counties for this work totalled \$1,600,000, the work covering the entire state system of roads.

During the past two or three years, considerable dissatisfaction has been expressed by officials of the U. S. Bureau of Public Roads with the maintenance work done on federal aid roads in Colorado. Following a conference with the head of the bureau held in Denver in October last, the Highway Advisory Board announced that it would authorize the state highway engineer to take over the maintenance of state roads in Colorado in 1928. This was strenuously objected to by a number of county officials. It was said, however, that the U. S. bureau had issued a statement which practically amounted to an ulti-

of the paddles at 3¾ revolutions per minute, for the amount of waste treated, is given by the Junior author as amounting to 1.3 k.w.h. The maximum kill of animals, which comes on Mondays and Thursdays, amounts to 80 hogs and 20 cows.

⁵The Analyst, March, 1927.

matum to the Colorado department, that unless the maintenance work was improved, government crews would be used to make the necessary repairs and all federal aid money would be withheld from the state. Under these conditions the county officials finally agreed to this action.

Under the 1928 budget there will be approximately \$232 for every one of the 3,360 miles of federal aid roads. If the county commissioner system had been continued, only \$190 a mile would have been

Plans of the highway department call for the employment of 125 patrol crews to handle the work, each crew looking after an average of 25 miles of roadway. Each patrol will consist of two men and

will be supplied with modern equipment.

Included in Colorado's federal aid system are 260 miles of concrete or asphalt roads, 477 miles of high type gravel surface roads, 55 miles of sand-clay surface roads, and 248 miles of graded roads. There are 2,295 miles of roads in various stages of improvement from plain dirt to gravel surface.

Road Maintenance Equipment*

Suggestions for determining the type of equipment desirable for a given job and choosing the make

The principles of scientific management are seldom applied to public road maintenance, chiefly because, first, it is not generally conducted for a profit and the results of efficient management and proper methods are not measured in dollars and cents, but in convenience to the public; and second, because the amount of work necessary to obtain the desired result is not always easy to predetermine and to specify, and there is no uniform system of cost accounting upon which to base comparisons of efficiency.

Like other construction work, maintenance requires the same type of planning and the same type of managing and directing ability. The same methods are adaptable, whether a piece of work is let by contract or is done by maintenance forces, and the same type of management should be applied.

A few years ago the magnitude of a job was gauged by the amount of man power involved. The speed with which it could be accomplished was often fixed either by the labor market or by the number of men who could work without getting in each other's way. In those days, efficient management consisted of a dominating personal force by which the possessor obtained more than a normal amount of work from the laborers.

With higher cost of labor and improvements in equipment there came gradually a partial substitution of the latter for the former, and with this, a study of the conditions under which men and animals and machinery respectively worked to the best advantage. The old days have passed, and modern management calls for a knowledge of business methods, the rules and usages governing purchasing power, financing and cost keeping, and a knowledge of the laws limiting, as well as protecting, construction activities. The application of these scientific principles, which have been more recently glorified by the term "production engineering," includes a study of the work to be done, the adoption of economical methods, the employment of men who can do their work easily rather than those whose energy is spent in overcoming unnecessary difficulties, the selection of the proper tools and equipment, and the arrangement of the organization so that a proper balance is maintained between its various integral

There is an old axiom which has a direct application to equipment—"If you need a tool, you pay for it whether you buy it or not." That this is not generally recognized is due to the fact that there is no column in the ledger in which to set forth the amounts of money unnecessarily spent on account of not having the proper equipment. These amounts may be approximately determined by a comparison of costs on similar kinds of work with and without equipment, but such comparisons should be made only with a full and complete knowledge of all the

conditions and elements affecting the job.

The selection of equipment involves determining the type of equipment which is desirable, and the particular make which will best suit the conditions.

DETERMINING THE TYPE OF EQUIPMENT

Since the general problem of road maintenance is to do certain work in a satisfactory manner at the minimum cost, it is well to know what elements go to make up the total cost, and what effect equipment has on it. From this standpoint, costs may be classified under three heads:

1. Productive costs, which include the expenditures for labor and operation of equipment actually engaged in pro-

2. Non-productive costs, such as moving to and from the job and getting it organized, and charges for depreciation

on equipment, insurance, etc.

3. Delays, which may be charged either to poor management, equipment break-downs, or weather conditions. While this third group does not appear as a separate ledger account, it has a very important bearing upon the cost of the work.

The selection of equipment and the adoption of methods are interdependent. It is obvious that these two go hand-in-hand. Once they have been determined, the job costs per day are fixed within very narrow limits. The only way to reduce the unit costs, or the cost per mile, as the case may be, is to increase the output. It costs the same to operate a given grading outfit, whether five or ten miles are covered in a day.

Productive Costs. Most work consists of several operations which must be properly coordinated in order to obtain the proper results. Thus, earth moving consists of:

(1) Loosening the soil.

(2) Loading. (3) Hauling.

(4) Placing, which includes spreading and compacting.

^{*}Abstract of paper before the Montana Highway Officials' Annual Convention by F. J. Nikirk, highway engineer, Caterpillar Tractor Company.

On a well organized job the relationship of one of these operations to another is apparent. The equipment in each must be balanced with the others.

The major production unit must be kept working at as near its rated capacity as possible. The ratio of the actual production to the output capacity has been termed the "load factor." To keep down unit costs, it is necessary to keep the load factor as high as possible. This is particularly true of the primary unit. Secondary equipment should be arranged to meet the requirements of the primary producer. Often a slight excess of this secondary equipment is advisable to provide against minor delays.

Non-Productuve Costs. It is important also to keep in mind the non-productive costs. A steam shovel may be an ideal piece of equipment to use on a certain line change, providing it were on the job, but if it costs \$1000 to move it to and from the job, and the yardage to be moved is small, this non-productive expense may make the cost per yard excessive. As another example, we may take an expensive piece of snow removal equipment which, though efficient, is so constructed that no part of it can be used for any other purpose. If such equipment be used only thirty or forty days per year, the annual charges, distributed over these few days, makes its daily cost run high.

Delays. The possibility of delays must also be considered. The loss of time in a single operation may be very small, but if recurring often enough during the day, may amount to considerable delay. Men left to their own devices may adopt poor methods of handling equipment, and continued experience tends to fix the poor way rather than to develop a better one.

The type of machine should be selected which is adapted to the particular kind of work, and which may be relied upon to continue in service for a reasonable period of years, with the minimum number of break-downs. Such break-downs not only entail a cost for repairs and parts, but they add a greater cost due to disrupting the organization. Though sturdy construction is a primary requisite, the proper care of equipment helps to reduce delays due to break-downs.

Weather conditions also have an effect upon the cost of the work,—hence the need of selecting equipment that will be least affected. Adverse weather may be classified:

- 1. Wet Weather.
 2. Hot weather.
- 3. Cold weather.

The effect of the weather may be either to conduct the work at a reduced rate of output, or even to cause a complete stoppage of the work.

CHOOSING THE MAKE OF EQUIPMENT

Having determined the type of equipment to be used, with full consideration of its "adaptability"—that is, the ability to do the maximum amount of work at the lowest unit cost, and the ability to fill the needs for the greatest number of days per year—the next problem is to select the particular make of equipment

In selecting the make of machine, due consideration should be given to the character and reputation of the manufacturer; the service rendered by the dealer; the capacity and performance of the machine; its sturdiness and lasting qualities; its ease of operation and positive control; and lastly, the

Only to often, equipment is purchased by just plain "price buying," without regard to the merits of the particular machine or the service rendered by the dealer. Any machine is liable to require parts occasionally, and these should be furnished promptly and at a reasonable price. Delays due to poor service on repair parts are expensive.

A prominent State Highway official recently made a statement as follows:

A particular type machine has not established its right to serious consideration until it has been operated under typical conditions for a year or more. Do not construe from this that the purchase of new designs is undesirable. Every state should buy new developments of machinery adapted to their work, but such purchases should be limited to a few experimental outfits, until the machine has proven itself. Personally, I do not look with favor upon so-called "demonstrations." I never yet saw a machine fall down on a demonstration. A clever operator and wisely selected road will put over any machine for a few days or weeks.

Also look to the power of any equipment you are considering. Horse power ratings are not always reliable, and an under-powered machine is a constant expense and irritation. The fuel cost is another item which should be investigated. It is not enough that the machine does the work required of it, but it should do this work at an economical

Then, last but not least, in determining the dealer from whom you will make your purchase, keep in mind that it is always desirable to deal with a well established firm. Our junk yards are full of useless orphaned machines. The amount of money represented by this junk is a tremendous sum, and, in my mind, is one of the few public road expenditures which is open to criticism. In this day of rapidly changing conditions and methods, it is a problem for any machine company to keep its equipment abreast of the times. Machines are continually developing weaknesses, and proving unequal to the constantly increasing tasks to which they are put. These so-called "bugs" require study and adjustment. If, when a machine is sold, the seller considers the deal closed, that machine is an undesirable purchase. Be sure the company you deal with is one that takes an interest in its sales, not only until your name is signed on the dotted line, but continually thereafter through the entire life of the machine.

UPKEEP

Having once purchased the particular equipment, care is another item. Road machinery should be properly housed, well lubricated, and kept painted. An operator is less apt to abuse a machine that is kept in good condition, and will take a pride in one which has a good appearance. Pride in the appearance and performance of equipment is also a factor in the output.

Put machinery in the hands of a trained operator who will use it efficiently and not abuse it. Keep it well housed, well painted and well lubricated.

New York Highway Specifications

The New York State Department of Public Works on January 2, 1928, adopted specifications which contain some new features, which will undoubtedly be reflected in increased costs.

The time for mixing concrete batches has been increased from one minute to one and a quarter minutes after all the materials are in the drum.

At all street and highway intersections or other points where it is desired to open the pavement to traffic earlier than usual, the mixing time required will be five minutes.

The item of overhaul has been entirely eliminated

from all contracts, requiring this item to be included

in the price bid for excavation.

The new specifications call for longitudinal dowels at all transverse joints. These are to be supported by chairs and to pierce through the bulkhead and the transverse expansion joint, which means that the bulkhead will have to be slotted where the dowels protrude. This operation will delay the work and contractors will undoubtedly take this into account in figuring pavement costs.

Subgrade Soils and Pavement Durability

Result of field studies made with a view to developing method of identifying good, fair and bad soils

Albert C. Rose, associate highway engineer of the Bureau of Public Roads, in a paper published in the January Proceedings of the American Society of Civil Engineers entitled "Foundations and Drainage of Highways," gave the result of field studies made by him in the Pacific Northwest with a view to developing simple and practical field tests and methods of identifying good, fair, and bad subgrade soils. He said that "A careful analysis of engineering literature indicates that pavements or surfacing design involves four major variables: (1) the character of material in and the quality of the workmanship on the surfacing; (2) the local climatic conditions; (3) the character and conditions of the subgrade soil; and (4) the kind and amount of traffic." Of these four, "the subgrade seems to be the most important; and in the subgrade the volume changes caused by variation in moisture content and frost action are the factors that seem to be of the greatest concern to the highway engineer. It is granted that no road surface would go to pieces without heavy traffic, but the distortion of the subgrade due to volumetric changes must first take away the support from the surfacing before a pavement will go to

"As a result of the investigation the volumetric shrinkage of the soil was concluded to be the fundamental adverse factor. For measuring this, a linear shrinkage test was devised, as the displacement of pavements seemed to be caused principally by the distortion of the subgrade in one direction—vertically. The procedure for the field moisture equivalent test was devised to prepare soils for the linear shrinkage test by wetting them with comparable quantities of water; but later it came to have a value of its

own.

"These tests were used on existing sub-grade soils, and the corresponding pavement conditions were observed. It was noted that an increase in the clay content of the soil, which was indicated by the test values, was accompanied by a corresponding adverse condition of the pavement.

"Taken together, the field observations led to the conclusion that certain test limits could be used to identify good, fair, and bad sub-grade soils for the purpose of making a detailed sub-grade survey, A trilinear soil-classification chart, used in combination with a U. S. Bureau of Soils map, further simplified the work and made possible reconnaissance sub-grade surveys without detailed tests.

"The linear shrinkage and field moisture equivalent percentages were used to determine the character of the sub-grade soil as a foundation. The stability ratio was used to measure the drainage

conditions.'

The field moisture equivalent is found as follows: The soil is powdered to pass a 1 m. m. screen and water dropped from a burette on the sample in an iron bowl with constant stirring. When the material has obtained the consistency of putty it is compacted and the water allowed to drop on the surface as long as it is abserbed. When the absorption is complete, the surface assumes a wet, shiny appearance which indicates the critical point of the test. The water content of the soil, divided by the dry weight of the soil and the result multiplied by 100 gives the field moisture equivalent. This cannot be accurately determined for a value under 20, but soils of lower value are so coarsegrained as to drain readily and therefore are practically always good subgrade soils. Soil so mixed was molded into 1" x 1" x 10" bars and shrunk to determine the linear shrinkage value, which was considered to be the difference between the wet and dry length of the bars computed as a percentage of the wet length.

This linear shrinkage was considered the more reliable test, but it was found that a general relation existed between the values of the field moisture equivalent and the linear shrinkage and that for tentative investigation 'the former was indicative of the result to be obtained by the latter,

which is the more difficult test.

"Field observations indicated that for the purpose of making sub-grade soil reconnaissance surveys, the clay contents by mechanical annlysis may be considered equal to the field moisture equivalent. When this equivalent was less than 20 the linear shrinkage percentage was usually negligible and the soil made a good sub-grade; when the field moisture equivalent varied from 20 to 30, the linear shrinkage percentage usually did not exceed 5 and the soil made a fair sub-grade; and when the field moisture equivalent exceded 30, the linear shrinkage percentage usually was greater than 5% and the soil made a poor sub-grade. The results vary considerably in individual cases and are based on observations made in the Pacific Northwest. Before they are accepted for any other region, or any particular project, they should be verified by actual "Although not 100% effective, the tests were, however, significant in the great majority of cases, and it is believed that they will be of value to the field engineer until some simpler and more effective method is devised." They are now being

used by the state of California and have been included in those under investigation by the U. S. Bureau of Public Roads.

When auger borings are made into a soil, and the moisture content of the sample so obtained is determined, neglecting the top three to six inches, this content divided by the field moisture equivalent, both in percentages, is termed the "stability ratio" of that soil. When the stability ratio of a sub-grade is greater than one, the soil is considered to be in an unfavorable condition. In well drained soil the stability ratio is always found to be less than one, even in the rainy season and within three or four hours after heavy rainfalls; while on poorly drained soil it generaly exceeds one.

The author drew the following conclusions from his studies:

"1.—The adverse character of the sub-grade soil depends primarily on the volume change caused by variations in moisture content or frost action. The main adverse action of the volume change occurs in one direction—the vertical.

"2.—The volume changes of the soil distort the sub-grade, which displaces the pavement unevenly and subjects it to excessive localized stresses.

'3.—The adverse character of the subgrade soil is shown to increase with the clay content.

"4.—The clay content and adverse character of the sub-grade soil is indicated by certain simple and practical field tests, called the field moisture equivalent and the linear shrinkage tests.

"5.—Detailed sub-grade soil surveys may be readily made by using U. S. Bureau of Soils maps in connection with field tests.

"6.—A simplified and rapid method for making a reconniassance soil survey is by the use of a U. S. Bureau of Soils map in connection with a trilinear soil classification chart, without the use of field or other tests. Generally speaking, sands, sandy loams, loams, and silty loams are considered good sub-grade soils; sandy clay loams, clay loams, silty clay loams, sandy clays, and silty clays, doubtful sub-grade soils; and clays, bad sub-grade soils.

"7.—The drainage condition of a sub-grade soil, as well as the bearing power, is indicated as poor when the critical point—a stability ratio of one—is exceeded. The stability ratio is defined as the moisture content divided by the field moisture equivalent."

Gasoline Consumption in 1927

Gasoline consumption by automobiles in 1927 totalled 11,563,490,000 gallons, according to the American Road Builders' Association. California used more than any other one state, 1,017,681,000 gallons, while New York came second, with 892,800,000 gallons. Nevada had the lowest record, 12,720,000 gallons.

The average consumption per registered motor vehicle was approximately 550 gallons. Estimating on a basis of 13½ miles per gallon, this gives more than 150,000,000,000 miles travelled by automobiles during the year

At the close of 1927 only two states, Massachu-

setts and New York, were not imposing a tax on gasoline. (The Illinois tax law has recently been declared unconstitutional.) Accurate figures for the gasoline taxes paid during the year were not yet available, but are expected to run well over \$200,000,000.

Grade Separation of City Streets

A proposed grade separation for two highways suitable for use in subdivided or built-up communities has been designed by the Cook County (Chicago), Illinois, Highway Department. It has in common with all such two-level crossings the advantages of greatly increasing the traffic capacity of both main thorofares, of making crossing delays a thing of the past, and of reducing to a minimum intersection accidents.

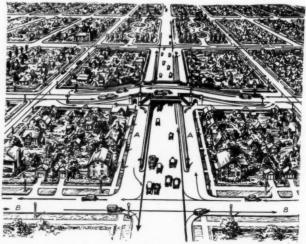
For the improvement, a right-of-way 120 feet wide is needed for at least a block each way from the grade separation corner.

In addition to building the grade separation itself, it is proposed that the county pave the streets entirely around each of the four blocks of land affected by the two-level structure. These streets will form the right-hand loops ("B" on diagram) that replace the left turns from one main thorofare to the other.

The county also proposes to provide 24 feet of paved street space at grade for all property fronting on either of the main highways at or near the grade separation corner ("A" on diagram). These pavements provide for entrance to abutting buildings and for the right turn from one main highway to the other.

Corner property on all eight of the intersections affected by the loops (a matter of 32 corners) is improved for business purposes. Furthermore, it is believed that both the widening and paving of the loops by the county, and the increased travel around the loops caused by the two-level crossing, will enhance the value of all property fronting on them.

The county plans to build a structure on this plan during the present year and, together with the Grade Separation Committee of the Chicago Association of Commerce, is studying other methods and other important intersections with a view to extending the number of two-level crossings later.



GRADE SEPARATION OF TWO HIGHWAYS.





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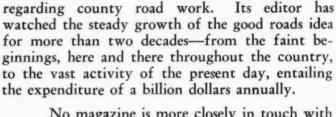
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18TH ANNUAL

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Getting Ready for Spring Floods

The possibility of contamination of water supplies if the usual spring freshets and flood conditions occur has been called to the attention of waterworks officials and water companies by the Division of Sanitation of the New York State Department of Health. Despite the relatively small snowfall in portions of the east, heavy spring rains falling on saturated ground may result in flood conditions. The statement also calls attention to the fact that the contamination of water supply streams during these flood periods is relatively more serious than at seasons of low flow. At such times, surface wash carries into the streams filth from animal enclosures, privy vaults and cesspools which has been accumulating for a number of months. Under the influence of rapid stream flow this contamination will reach the intake of a water supply comparatively soon and, consequently, the danger of pollution of the water supply is correspondingly greater. In the case of supplies obtained from wells or springs contamination may occur due to the unusual high level of the ground water arising from flood condi-

Waterworks officials should be ready for the emergencies that may arise: they will not be faithful to their trust unless they provide every modern safeguard against danger. That purification plants should be gone over and put into first class condition, that water-sheds should be inspected and sources of danger eliminated goes without saying. Also, such additional equipment as may be required to provide an adequate margin of safety should be secured at once, for when needed it is of little benefit unless put into service immediately.

A New Traffic Problem

If we assume, as approximation for easy calculation, that there is one car in the United States for each five persons, that a parked car withdraws from other service 300 square feet of street surface, and that at some one time about one-sixth of the cars are parked in the streets, we have a parking space occupied equivalent to 10 square feet per capita. This gives us one acre of parking space for each 4,356 persons. In the densely populated cities in the middle Atlantic states, the average density is about thirty persons to ten persons per acre of total urban area. This figures out about one half of one per cent of the total area of the city occasionally required for parking purposes.

sionally required for parking purposes.

In a recent article entitled "Airports as a Factor in City Planning," E. P. Goodrich anticipates the development of the use of airplanes to ultimately one for each ten of the population, and estimates that when this time arrives a landing field or runway would be required for each two thousand population. Fields now actively in use vary all the way from 1000 acres at Mitchell field to 40 acres at Boston and Pittsburgh. If we assume 50 acres as the smallest size generally desirable, we have one acre required for each 40 population. This is one hundred times as much as the maximum area just figured as necessary for automobile parking space, and is equivalent to about one half of the entire area of the average large city.

When we figure that a landing field requires spe-

cial topographical conditions, such as a comparatively level ground readily drained, and without surrounding buildings or trees to interfere with the rising of airplanes from the landing field, the problem of the future in locating in or near each city an area fulfilling these qualifications and equal to one-half the total area of the city, will naturally present itself as a staggering one. If any condition approximating that herein forecast arrives, the city planner of the future will certainly have his work cut out for him

That such a condition is not entirely visionary may be judged from the fact that Chicago already has 15 landing fields, Los Angeles has 8, while in California there are 100 fields, 84 in Texas, 64 in Illinois, 50 in Ohio, 40 in Oklahoma, 30 in New York, 29 in Arizona, 22 in Colorado and 24 in Iowa.

It may at least be said that the point has been reached where every city should bear in mind the demand at present or in the very near future for at least one landing field at each city and several fields for the larger cities; and land for these should be selected and purchased now, while the land is comparatively cheap, in anticipation of the needs, just as cities have for years past been purchasing land with a view to developing parks thereon.

Surety Bonds for Michigan Highway Contracts

Notice has been sent out by Frank F. Rogers, state highway commissioner of Michigan, that in the future the Michigan State Highway Department will require surety bonds on all contracts the face value of which exceeds \$10,000. "This action is taken for the purpose of establishing a uniform basis for bidding on highway, road and bridge projects, and to properly secure the construction and payment of lien claims."

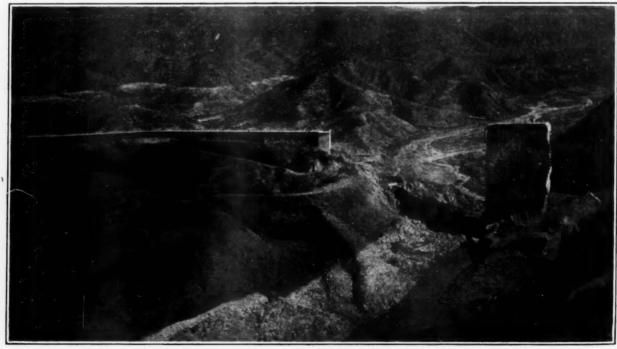
The St. Francis Dam

Every citizen must be appalled at the loss of life occasioned by the giving way of the St. Francis dam of the Los Angeles Aqueduct. The latest news we have gives the known dead as numbering 236 with 200 more still missing; and the financial loss as running into several million dollars.

Every engineer must have been startled at the



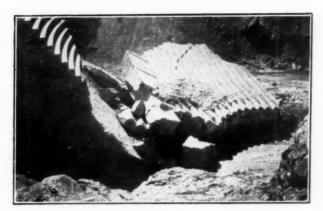
WHERE WEST WING BROKE AWAY
Shows rock on which it rested, said to be soft when
saturated



VIEW OF ST. FRANCIS DAM, LOOKING UP STREAM (NORTH)
Shows the only part of the dam left standing. The joint between the two kinds of rock shows clearly on the left

failure of this dam, wondered what could have caused it and what the effect may be upon the prestige of hydraulic engineers in the minds of the public.

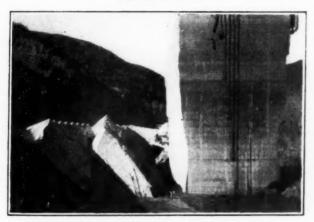
This dam was one of the latest of many gravity



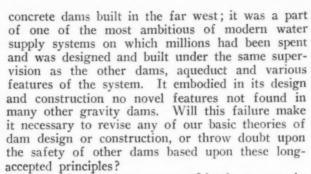
MASONRY FROM EAST END OF DAM

Note that it is lying with its foot down stream and

coping up stream



UP-STREAM FACE OF STANDING SECTION
A group of five men at the left of the base of this
standing section gives an idea of the size of the blocks
of concrete at the left—the east end of the dam lying
on its up-stream face



As to the last, we can confidently answer in the negative. Too many dams have withstood the heaviest floods for too many years to cause any doubt on this point. The exact cause of this failure it would be rash to assign until reports have been received from the several investigation commissions that have been appointed. But there seems to be every reason to believe that the failure of a part of the foundation was the sole cause.

At this writing (March 28th) newspaper synopsis of the report of one of these commissions—that appointed by the governor—dated March 27th is just at hand. This states that: "Failure of the dam was due to defective foundation. There is nothing to indicate that the accepted theory of gravity type dams is in error."

This dam was about 205 feet high at its deepest point, and was 650 feet long. The central and eastern portions were founded on a fairly good shale. The western third was on what was called red conglomerate which (says the commission) "is of such nature that when entirely dry it is hard and rock-like in appearance and characteristic, although defective in compressive strength." But samples taken since the disaster soon softened when immersed in water.

The failure to learn beforehand the total unsuitability of this rock to support a dam is apparently the unaccountable and inexcusable error committed by those who planned it.

A careful study of the photographs and descrip-

tions of conditions (there are no eye-witnesses of the failure) seem to us to indicate that the soft rock under the west quarter of the dam yielded under the pressure of nearly 200 feet of water and masonry, was washed out to a depth of ten feet or more below the concrete, leaving the toe here unsupported, when the west third of the dam suddenly gave way. All of this was carried a thousand feet or more down stream, some in enormous blocks larger than

Most of the width of the reservoir here lay northwest of this gap, and the water rushed across the downstream face of the dam to the east side of the canyon in a wave



THE SAN FRANCISQUITO CANYON 1½ MILES BELOW THE DAM
At the bottom of the picture are seen two generators—all that is left of power
house, which was completely swept away.

nearly two hundred feet high which climbed up this side to an elevation higher than the top of the dam, also scouring out soil and some rock along the toe. Meantime the level of the water immediately behind the dam had been drawn down by the sudden rush through the break. Thus the resultant pressure against the dam at the east end was up stream-a condition which, with its nearly vertical back, it was not designed to withstand. This end then toppled up stream, the water rushed out under it and carried the base a short distance down stream, while the coping fell up stream—where the photographs of the broken dam show it to be lying. This would perhaps ex-plain also why the face of the standing section of the dam was torn off at the bottom but not at the top.

Sanitary Engineering Advice Needed

Under this heading an editorial in the January number of Public Works called attention to the fact that in relief work, such as that following the Florida hurricane and the Mississippi flood, engineering advice has not generally been sought, despite the evident fitness of sanitary engineers to cope with such problems. This editorial has brought forth a number of responses from engineers, some of whom are well acquainted with the conditions.

The following letter is from Abel Wolman, chief engineer of the state Department of Health of Maryland:

I have read with a great deal of interest the editorial in the January issue of Public Works, entitled "Sanitary Engineering Advice is Needed."

The point which you stress, namely, the absence of sanitary engineering advice or participation in the activities associated with relief, is well taken. It has seemed to many of us during past years that the engineer is called into these matters rather belatedly and in some cases is assigned to a type of activity in which his judgment and experience are not advantageously used. Where the problems of relief frequently involve solutions of a sanitary engineering nature, it is unfortunate that the personnel capable of undertaking such work is not permanently at hand and is not called into the council.

As is frequently the case, these lapses may be due to pure oversight. Bringing the matter to the attention of the pro-per authorities is frequently the only necessary step. I hope that your editorial may succeed in improving the sit-

H. E. Miller, director of the Bureau of Sanitary Engineering, North Carolina State Board of Health, writes as follows:

I have considered carefully the editorial on page 34 of the January issue of Public Works and I quite agree with you that there is conspicuous deficiency in provision for the services and correlation of activities in the sanitary engineering field with respect to the disaster relief work. I think that this applies generally to the work that has been conducted in connection with our recent disasters throughout the country.

disasters throughout the country.

In my opinion the most forward step that has been taken in connection with handling these features was that of correlating public health activities through the State Health Department in the Mississippi flood zone. The great difficulty in connection with this situation, however, was that at headquarters the Red Cross had only medical advisers. These men had neither intimate knowledge of where to draw the proper sanitary engineering personnel, nor knowledge of how to appraise the sanitary engineering need of the flooded area.

The contagious disease rates in the flooded area stand out as a monument to the work done, but an analysis

out as a monument to the work done, but an analysis of the situation will, I think, show quite clearly that the

real fundamental basis of this illustrious accomplishment was rigid environmental sanitation of the concentration

camps and emergency water supply protection.

Inasmuch as five men out of my own division were detailed to the Mississippi river valley emergency work, I feel that I am speaking advisedly when first I pay tribute to the tremendous advance made in this case over previous disasters in the utilization of sanitary engineers and sanitary inspectors in a worth-while fashion, but conclude that the machine could have been operated much more efficiently and could have struck its stride much more quickly had the headquarters staff included an engineer experienced and familiar with sanitary engineering sanitation and the resources available for this service comparable with the experience of the U. S. Public Health Service medical officer in the medical phases of public health who was assigned to the headquarters staff.

In this connection the Conference of the State Sanitary Engineers has recognized this question and has appointed a committee composed of State Sanitary Engineers who have been intimately associated with disaster relief work in their several states. This committee is instructed to draft an outline of procedure and activities and suggest

organization principles for meeting readily, systematically and effectively these conditions in the future.

As chairman of the Conference of State Sanitary Engineers, I am very much interested in this and look forward with much interest to the report of this committee

of the Conference.
I am pleased to observe the interest that Public Works is indicating in this matter and I sincerely hope that all engineering journals will give this important problem serious consideration.

The director of the Division of Sanitary Engineering of the Tennessee Department of Public Health, Howard R. Fullerton, writes:

The trained sanitary engineer has very important duties to perform on these occasions. He is the one person that understands the repairing, operating and safe-guarding of the public water supplies and the private supplies, as well. This is of the utmost importance when we remember that with only a few minutes of pumping of polluted water into city mains the health of all residents is put in jeopardy.

Immediate general sanitary precautions are always needed. The trained sanitary engineer is well qualified to take active charge of work of this type because it is work he is called upon to do almost daily in active practice.

In addition there are a multitude of other problems of a sanitary engineering nature that arise in the usual great disaster when a large number of people are affected. The organization of sanitary workers on a practical basis is a problem that a sanitary engineer can handle with efficiency and dispatch.

I believe that the Red Cross, which is the official agency for relief in these disasters and emergencies, should be provided with or provide adequate advisory sanitary engineering service. Take the recent Mississippi flood for instance. The various states affected aided through their divisions of sanitary engineering and the service rendered by national organizations and departments was all very splendid, and the service of the Red Cross rendered the various stricken states was marvelous; but the Red Cross did need a board of advisory sanitary engineers or a chief sanitary engineer to co-ordinate the sanitary engineering work and direct the same as a whole.

The article in Public Works on these matters should be given careful consideration by all public health officials, as well as by those interested in public health or the general welfare of the public.

A two-page letter from a well-known engineer in Philadelphia, who had personal (and apparently unpleasant) contact with the Red Cross at the time of the Florida disaster has been received, as have a number of personal messages to the editors. The Philadelphian starts off: "Your editorial . . . is certainly mighty well-timed and entirely appropriate. That very thing has been a sore spot with me for some time and I intend unloading it right now." He tells of being shown scant courtesy as

well as no appreciation by Red Cross heads when he offered his services.

A man promient in sanitary engineering circles in West Tennessee, in a personal letter regarding the editorial, states that unfamiliarity with engineering methods and procedures was an important difficulty in the Mississippi work. He adds: "I do not mean that the Red Cross did not—and are not—doing a lot of good in the flooded district, but they had a lot of red tape about their work. . . ."

An engineer of the U. S. Public Health Service who was on duty for several months in the Mississippi flood district gives much credit to the state sanitary engineers of the flood area states, but says that they were not called into active service and allowed to coordinate their activities until the emergency became great, and then only upon the insistence of State and Public Health Service officials.

New Jersey Sewage Works Association

Abstracts of papers presented at the Thirteenth Annual Meeting at Trenton, N. J. Odors and odor control, methods of determining pH, size of sludge beds, and troubles with Imhoff tanks

Operation of Plants. The meeting opened with a round table discussion of questions on operation. Paul Molitor, speaking on the subject of the preparation of sand beds for winter, stated that at the Chatham-Madison plant, (of which he was superintendent) it was the practice to heap up mounds of sand on 4-foot centers. This gave increased filter area after ice had formed, and the beds were easier to clean in the spring. The operator of the Worcester, Mass., plant stated that their practice was substantially the same, but that scum composed the main part of the piles.

the main part of the piles.

Determining pH. Methods of determining the pH of sludge were discussed by Anthony J. Fischer of the New Jersey Agricultural Experiment Station. He stated that for the average condition the colorimetric method was preferable to the electrolytic method, though not quite so accurate. Samples should be taken from the scum, the top, the liquid and the bottom to show true conditions. Samples are opaque, and must be cleared in order to make them suitable for use with color solutions. The best way of clearing is by the centrifuge, but this is not always possible and filtration may be used.

Well digested sludge gives a fairly clear effluent, but the usual effluent from sludge is turbid. There are various means for clarifying effluents, of which filtration through glass wool is probably the best. Following the paper by Mr. Fischer, Wellington Donaldson brought out the fact that some glass wool contains chemicals which may change materially the results.

In regard to uniformity of results, P. N. Daniels stated that he used four separate methods and averaged the results.

Size of Sludge Beds. The most convenient size of sludge beds was next discussed. Franklin Diggs stated that the beds at Towson, Md., were twice as long as they were wide, and that the sludge was applied to the center of the bed and reaches all corners at about the same time. M. B. Tark stated that 90% sludge will run about 100 feet per minute, and that the limit of size of beds should be about 80 feet wide. It was brought out that flexibility, as a rule, demands at least four units. In small plants, this will govern; in larger plants the methods of removal will probably dictate the size.

C. M. Nichols of the New Jersey State Department of Health demonstrated methods of the determination of free chlorine. W. A. Taylor and L. H. Enslow discussed the methods illustrated, Mr. Enslow stating that a ten-minute contact with ½ ppm residual chlorine is sufficient for settled or filtered sewage, less than 100 B. coli resulting usually from such treatment.

A paper on "The Value of Improving the Appearance of Disposal Works," by J. F. Skinner of Rochester, N. Y., was read by William A. Ryan. Other papers on the subject, some of them illustrated with lantern slides, were presented by Paul Molitor and Ed. F. Shissler.

Odors and Odor Control. A symposium on odors and odor control was of much interest and brought out a great deal of valuable information. Dr. Willem Rudolfs enumerated the causes of odors and recounted the results of some of the experiments carried on under his direction. He considered organic sulphates as important causes of odors. These may come from organic wastes or may enter by seeping into the sewers. Among the causes listed were natural waters containing sulfates, anilin dye manufacturing plants, bleaching processes, pottery plants, galvanizing processes, gas works, copper industries, metal industries in general, sulphuric acid industries, paper plants, creameries, slaughter houses and the addition of sea water.

As to the relative hydrogen sulphide producing propensities of the various sulphates, he gave the following data: Iron, less than 1%; zinc 1%; aluminum 2%; sodium 8%; sulphuric acid 14%; copper sulphate 24%; calcium sulphate 42%; magnesium sulphate 62%; ammonium sulphate 85%. Under various conditions, the production of any of these may vary due to the following possibilities: Changes in digestion caused by the sulphate, retardation in activity of certain organisms, or type of sulphate introduced.

Leroy Foreman, senior chemist of the State Health Department, told of an investigation of the odor production of the Haddonfield plant. A systematic investigation of each unit of the plant with regard to its odor producing importance was made. It was found that every part of the plant was contributing to the odor nuisance, though not in equal proportion. The open conduit carrying the sewage into the plant created a typical sewage odor. Grease, etc., on the walls of the plant gave off a rancid and disagreeable odor. The effluent produced considerable odor. The sprinkling filters during and just

after spraying were very disagreeable. The secondary tank was not so bad, but the gas vents of the settling tank and the sludge beds were, at times, exceedingly disagreeable. Investigation of the production of hydrogen sulphide showed that from 1 AM to 3 PM, matters were not so bad, but that from 3 PM to 1 AM there was very heavy production. The sewage at this plant was strongest from 9 to 11 AM, and the detention period was 2 hours

He stated that the best method of preventing the production of hydrogen sulphide was to add to the sewage as it entered the plant a retarding compound. Chlorine has been used extensively. Dosages of 14½ to 20 ppm were tried. The former dose reduced hydrogen sulphide 75%, bacterial count 70% and B. coli about 80%. There was no effect on the filter. The larger dose eliminated the hydrogen sulphide, there was free chlorine present at all times, B. coli were practically absent and the total bacterial were reduced 80%. There was no effect on the filter. A dose of 10 ppm was also tried. This reduced hydropen sulphide 30%. Chlorination from May to October probably is sufficient to eliminate odor trouble as there is little odor during the cool weather of the other months. Ferrous sulphate in dosages of 25 ppm has also been tried and its use is thought to improve the quality of the sludge.

use is thought to improve the quality of the sludge.

W. J. O'Connell spoke on "Odor Control by the
Use of Chlorine." He stated that the action of
chlorine in control of odors resulted from a checking of bacterial activity and a union of two parts
of chlorine with 1 part of hydrogen sulphide resulting in the formation of HC1 and free sulphur.
Possible means of dosing with chlorine include preliminary chlorination in the trunk sewer, chlorination at the entrance to the settling tank, and between the tank discharge and the dosing chamber.
The criterion is the control of hydrogen sulphide.
The proper dosage is such that the hydrogen sulphide is reduced to zero and there is a trace of
residual chlorine.

Air temperatures below 60 degrees reduce chance of odor nuisances. Summer months allow the production of odors unless care is maintained. Worst odors are usually between 5 and 9 PM. Peaks of H₂S production occur at 2 and 6 PM. Application of chlorine from 4:30 to 8:30 controlled nuisance at the Plainfield plant, though this may not be true at other plants. However, early evening hours are usually the critical ones. At Plainfield, a rate of 12 ppm is maintained, the chlorine being applied after screening. At few places will the application to the trunk sewer be satisfactory. Thorough mixing of the chlorine is desirable, and a solution feed apparatus is best.

Charles Capen described the design of a small plant in which all units are to be covered in order to prevent odor production. The sprinkling filter units are so designed that the standard units of sludge bed covers can be employed; the filter area will be 10,000 square feet, and the requirements are that they be odorless at a distance of 300 feet. It was found more economical to fit the shape of the filters to standard sludge bed covers than to adapt the covers to the filter units. The screen and grit chambers, dosing tank and secondary tank are all

covered; there is no place in the plant where the sewage is in contact with the outside air. The possibility of maintaining high temperature in the filter during winter is expected to give higher operating efficiency.

Imhoff Tanks at Newcastle, Pa.—"The Initial Operation of the Imhoff Tanks at Newcastle, Pa.," was given by Wellington Donaldson. This plant, which is planned to serve a population of 60,000, now serves about 50,000. It consists of a screen, having originally bars on 2-inch centers, but lately changed to 1-inch, six rectangular Imhoff tanks with reverse flow channels and having concrete roofs over the gas vents for gas collection, and twenty-four sludge beds each 20 by 100 feet.

The sewage is strong domestic. In the first year of operation there has been trouble from floating material, grease and oil. Settleable solids by the Imhoff glass range from 5.3 to 14 cc per liter. Sewage flow by Venturi meter averages 4.82 mgd, but varies between 1.75 and 11.8 mgd. The plant was put into operation in October, 1926. During the first five months of operation, tank behavior was regular except that gas production was exceedingly low; it reached 888 cubic feet per week in January, but fell to 120 cubic feet in March. This indicated unfavorable digestive activity. In April tests showed sludge to have a pH of 5.2 to 6.8, with CO₂ percentage in gas from tanks of nearly 50%. The addition of lime to the tanks was started in May and continued for several weeks, but the desired results not being attained, tanks were finally put out of service at intervals and contents recirculated with a sludge pump, and dosed with lime, and the pH was raised to 7.6.

The effect of the lime treatment was to increase bacterial activity and also gas production, which was shown by very pronounced foaming, which was believed due to the excessive amounts of solids which had accumulated during the winter and were not digested. To relieve this situation, the entire flow was put through one tank and the other five held out of service to permit digestion. The sludge was discharged into the river at highwater periods in order to prevent an overload on the sludge beds, but during June and July, a total of 24,000 cubic feet were handled on the beds. It was in poor condition and generally offensive.

According to usual assumptions, the gas production should have been 17,000 cubic feet per day, but during the first five months it averaged only 50 to 100 cubic feet. Gas increased to 25,000 cubic feet in September. Immediately after the liming, the gas quality was poor, with 63% CO₂, which has gradually fallen to 14%.

Other troubles have been caused by gas-lifted scum, mostly in the summer. To reduce the amount of solids entering the tanks, a smaller screen was substituted.

The conclusions are that the troubles are due primarily to putting the plant into service at the beginning of the winter, resulting in a large accumulation of undigested solids. In liming, it appears to be better to turn over the tanks with a pump and add the lime while pumping. It is wasteful to undertreat with lime. High CO₂ percentage appears to be a useful warning of abnormality of tank behavior.

Recent Legal Decisions

PERMANENT ROOF EXTENSIONS OVER SIDEWALKS HELD ENCROACHMENTS

The Illinois Appellate Court, Third District, holds, People v. City of Danville, 242 Ill. App. 472, that permanent roof extensions over public sidewalks are illegal encroachments and obstructions, and that a city ordinance conferring authority on the superintendent of buildings to issue permits for awnings within the fire limits gives no authority to issue permits for the construction of awnings or any other permanent roof covering over public sidewalks outside the fire limits.

BIDDER'S CERTIFICATE AS TO EQUIPMENT—ALTERNA-TIVE LUMP-SUM BIDS

Specifications for sewerage work contained a certificate of ownership of the equipment to be used by bidders and another as to the renting of that not owned. The lowest bidder signed the former, but not the latter, attaching instead an order of purchase of the required equipment, with an acceptance by the seller. The New Jersey Supreme Court held, Deininger v. Mayor, etc., of Englewood Cliffs, 136 Atl. 605, that this was a practical compliance with the demand; and that it would be against the interests of the taxpayers to set aside the lowest bid on this ground.

The specifications called for unit-price bids for each of the several specified classes of work, based upon an engineer's estimate of quantities, and also called for an alternative lump-sum bid for the entire work. The bidders made both bids, and the contract was awarded to the defendant on its lump sum bid. It was held that the award was not subject to the objection that a proper standard of bidding was not set up for the comparison of lump-sum bids; since the plans and specifications did not pretend to make any change in the standard set up for unit-price bids over that set up for lump-sum bids.

UNDER OKLAHOMA STATUTE CONTRACTS IN EXCESS OF ANNUAL ESTIMATED APPROPRIATION ARE VOID AS AGAINST MUNICIPALITY

In an action for the value of certain furnishings for a courthouse against a board of county commissioners, the plaintiff, by amendment, asked the court that, in the event the contracts were declared void, it be permitted to remove the property. Oklahoma Comp. St. 1921, section 8638, provides, in effect, that no liability exists against a county or any municipality thereof on any contract made in excess of the annual estimate. Section 8639 makes it a crime for any county or municipal officer to contract such a debt. The Oklahoma Supreme Court holds, Board of Const. of McCurtain County v. Western Bank & Supply Co., 254 Pac. 741, that section 8638 makes all contracts which fall within its inhibition void only as to the municipality. The provisions of the section became a part of every such contract. He who furnishes goods, wares, merchandise, or labor under contracts express or implied such as are referred to in the section, has only one remedy in the courts, a suit against the officers. This remedy being exclusive, he cannot recover the goods delivered from the municipality. He parts with the title, both legal and equitable, knowing who must pay, therefor; and, at his own risk, he accepts the responsibility of the officers individually for his pay. If he does not see fit to pursue his remedy against them, he cannot recover either the value or the property from the municipality.

ORDINANCES PROHIBITING CERTAIN OCCUPATIONS NEAR CHURCHES OR SCHOOLS

Courts should be very cautious, the Oklahoma Supreme Court says, in declaring a municipal ordinance unreasonable, there being a peculiar propriety in permitting the inhabitants of a municipality to determine what rules are necessary for their own local government. A city ordinance making it unlawful to install, maintain, carry on, operate, or run an oil mill, tannery, cotton gin, steam laundry, machine shop, blacksmith shop, or filling station, within 200 feet of any church building or schoolhouse, and declaring same to be a nuisance subject to abatement, was held a valid exercise of the police power.—Magnolia Petroleum Co. v. Wright, 254 Pac. 41.

BUYER'S AGREEMENT TO REPAY FREIGHT ON MATERIAL

A materialman who furnishes material to a contractor under an agreement that he should prepay the freight and the contractor should repay it as well as the f. o. b. price of the material may recover the freight from the contractor's surety as part of the purchase price. Whether the freight was paid in advance under agreement, or exacted of the materialman under his liability as consignor made, it is held, no difference. Maryland Casualty v. Ohio River Gravel Co., C. C. A. 4th circuit, 20 Fed. (2nd)

RIGHT OF FINAL INSPECTION UNDER PUBLIC WORKS CONTRACT

When the right of final inspection and approval of work already done under a public works contract is reserved, the government or the party in whose favor the reservation is made is not bound by partial settlements and acceptances as the work has progressed, and the arbitrator, at the time of final inspection, is the one clothed with authority to make the final decision. No set form of words is necessary in the contract to express the purpose to reserve the right of final inspection and approval. It is sufficient if the intention is clear and unambiguous. Warner Const. Co. v. Louis Hanssen's Sons. 20 Fed. (2nd) 483.

PRIOR RIGHT OF MUNICIPALITY UNDER PUBLIC WORKS BOND

The Ohio Supreme Court holds, Cleveland Builders' S. & B. Co. v. Village of Garfield Heights, 156 N. E. 209, that where a statutory bond is given to insure the contractor's fulfillment of a

public improvement construction contract according to its terms, the public has a right to enforce the bond in its favor in so far as it may be necessary to reimburse the public for any loss sustained by the contractor's default in carrying out the contract, and this right is prior to the right of any subcontractor, materialman or laborer to participate to any extent in the amount due on the bond.

BRACING OF SEWER EXCAVATIONS NOT REQUIRED UNDER BUILDING CONSTRUCTION REGULATION

Ohio Code of Specific Requirements of the Industrial Commission, sec. 71, requiring excavations incidental to building construction to be protected by bracing, shoring, or piling, does not require sewer ditches in streets to be braced. A sewer contractor covered by the Workmen's Compensation Law was not liable for an additional award as penalty for failure to brace the sides of a sewer ditch where a cave-in caused an employee's death. State v. Industrial Commission, Ohio Supreme Court, 156 N. E. 605.

WATER MAINS IN VILLAGE STREETS HELD A LOCAL IMPROVEMENT

The Illinois Supreme Court holds, Village of Downers Grove v. Bailey, 325 Ill. 186, 156 N. E. 362, that if the purpose and effect of an improvement are to improve a locality it is a local improvement although there is incidental benefit to the public, but if the primary purpose and effect are to benefit the public it is not a local improvement although it may incidentally benefit property in a particular locality. Whether an improvement is local or general is a question of law, but whether the facts bring the improvement within the definition of local or general is a question of fact. The construction of water mains on certain village streets, decreasing the fire hazard, was held a local improvement in business, industrial and multi-family apartment districts, enhancing the value of the property, and a special assessment therefor was held proper.

RIGHTS OF PARTIES CONTRACTING WITH MATERIAL-MEN AND SUBCONTRACTORS UNDER STATUTORY BOND

The Ohio Supreme Court holds, Southern Surety Co. v. Chambers, 115 Ohio St. 434, 154 N. E. 786, that materialmen and subcontractors may recover against the surety on a bond for the construction of a public building under the Ohio statute although the bond fails to comply with the statute in providing for payment for labor and materials.

The statute applies in favor of parties furnishing labor or material to a materialman or subcontractor. American Guaranty Co. v. Cincinnati Iron & Steel Co., 115 Ohio St. 626, 155 N. E. 389.

STATUTORY REQUIREMENT OF ADVERTISEMENT FOR BIDS

The Ohio Supreme Court holds, Ludwig Hommel & Co. v. Village of Woodsfield, 115 Ohio St. 675, 155 N. E. 386, that under the Ohio statute a contract of a village board of public affairs for supplies (in this case supplies and equipment for the village's electrical light plant) costing more than \$500 must be authorized by the council and adver-

tised. When either the requirement of authorization and direction by ordinance of council or of advertisement for bids has been omitted, the contract imposes no valid obligation upon the village.

COMMISSION'S JURISDICTION TO FIX SEWER RATES FOR COUNTY BUILDINGS NOTWITHSTANDING FRANCHISE CONTRACT

The Nevada Supreme Court holds, Tonopah Sewer & Drainage Co. v. Nye County, 254 Pac. 696, that the Public Service Commission has jurisdiction and authority to fix and authorize sewer rates for county buildings notwithstanding a prior franchise contract between the county commissioners and a sewerage company containing an exemption of the buildings from such rates, which contract was ratified by the Legislature prior to the creation of the Commission, although the act creating the Commission declared that it should not affect existing contracts.

PUBLIC AND PRIVATE PROPERTY OF MUNICIPALITY— FREEDOM FROM SEIZURE FOR DEBT

The federal district court for eastern New York holds, Shamrock Towing Co. v. New York, 20 Fed. (2nd) 445, that although property held by a municipal corporation for public use, such as public edifices, or their furniture or ornaments, or the public parks or grounds, or such as may be legally pledged for the payment of its debt, is not subject to seizure and sale on execution, in the absence of an express statutory provision authorizing it, (Leonard v. Brooklyn, 71 N. Y. 498) it is a general principal of law that the private property of a municipal corporation—i. e., that which is not necessary to the performance of the functions of government—may be seized and sold for the payment of debts.

STATUTORY POWER TO MUNICIPALITIES TO SELL OR LEASE LAND

The Florida Supreme Court, Bailey v. City of Tampa, 111 So. 119, holds that state statutes authorizing municipalities to sell, lease, or contract for the sale of lands held by them in trust for public purposes, are not in violation of section 10 of article 9 of the state constitution, prohibiting all municipalities in the state from becoming stockholders in, obtaining or appropriating money for, or in any wise loaning their credits to any corporation, association, institution, or individual.

CONTRACTS IN EXCESS OF MUNICIPAL ANNUAL REVENUE

Under section 26, art. 10, of the Oklahoma Constitution, the annual revenues of a municipality must take care of the annual expenditures; and any liabliity sought to be incurred by contract, express or implied, executed or to be executed, in excess of such current revenue in hand, is void, unless it be authorized by a vote of the people, and within the limitations therein provided. Anyone dealing with a municipality does so with notice of the limitations on its or its agent's powers, and if they go beyond the limitations imposed they do so at their peril.—Wilson v. Oklahoma City, Oklahoma Supreme Court, 251 Pac. 484.

NEWS OF THE SOCIETIES

Apr'l 17-19 — SOUTHEASTERN WATER AND LIGHT ASS'N. Atlanta, Ga. W. F. Stieglitz, Secy., Columbia, S. C.

April 23-24—NATIONAL MATERIAL HANDLING MEETING. Philadelphia, Pa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. Fourteenth annual convention at El Paso, Tex. M. E. Mc-Iver, Chicago, Sec'y.

June 11-16 — AMERICAN WATER WORKS ASS'N. Annual meeting at San Francisco, Calif.

June 25-29—AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting at Atlantic City, N. J.

Oct. 22-26—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention at Detroit, Mich.

MARYLAND WATER AND SEWAGE ASSOCIATION

This association will meet at the Southern Hotel, Baltimore, Md., April 10 and 11. At the Tuesday morning meeting, the following papers will be presented: Private or Public Ownership of Water Systems, by Robert B. Morse; The Advantages of Water Utilities Ownership—Parent Corporations vs. Municipal Corporations, by V. Bernard Siems; discussion, Carl Wolfe; Does the Municipality know what it Costs, by Thomas S. Durham; discussion, Maurice Goldstein and W. N. Kirkman; Fire Insurance Savings and Water Works Design, by F. H. Dryden; discussion, A. E. Walden and W. C. Munroe.

At the afternoon meeting, the following will be discussed: Garbage and Refuse Disposal for Small Communities, by Wm. Raynor Straus, discussion, John H. Gregory; Sewer Maintenance, by Milton J. Ruark, discussion, C. V. Joyce; The Value of The Residual Chlorine Test, by J. G. Patrick; The Most Acceptable Methods for the Determination of Residual Chlorine, by L. H. Enslow, open discussion; The Problems in Industrial Uses of Water in Stationary Steam Practice, by William Krumbine; Treatment of Water for Railroad Purposes, by R. C. Bardwell.

The business meeting and dinner will be held at 6:30 with Abel Wolman presiding. After the report of the secretary and the business meeting, there will be a general discussion of water system maintenance problems, as follows: Hydrants and Valves, J. S. Strohmeyer; Cross-connections and Their Elimination, E. J. Canton; Leakage Surveys, Albert Heard; Care of Standpipes, Tanks and Distribution Reservoirs, Frank Meyers; Inspection and Maintenance of Filter Beds, A. L. Gosnell and J. M. Jester; Maintenance of Regulating and Recording Devices, R. L. Moore.

Wednesday, starting about 11 A. M., there will be an inspection trip to include the Towson sewage works and the Baltimore incinerator. At the morning session, the following subjects will be discussed: Stream Pollution Prevention: Small Sewage Treatment Works

at Gaithersburg, H. R. Hall, discussion, C. E. Keefer; Treatment of Laundry Wastes, L. E. Sakers and F. M. Zimmerman; Swimming Pool Sanitation, M. J. Coblentz, discussions, Drs. E. C. Kefauver and V. deSomoskeoy and F. A. Korff.

NEW YORK STATE HIGHWAY CHAP-TER, ASSOCIATED GENERAL CONTRACTORS

The second annual convention of this organization was held at Syracuse, N. Y., March 14 and 15. About 500 engineers and contractors were present at the meeting and at the banquet following the business session Thursday evening.

The association adopted resolutions opposing the practice of the highway department in announcing engineer's estimates of the cost of highway work advertised for contract.

The following officers were elected: Eugene P. Forrestel, Buffalo, president; Louis Mayerson, Albany, vice-president; Charles D. Ream of Buffalo and Samuel D. Easton of Albany, new directors.

The following were re-elected: Richard Hopkins of Albany, secretary and treasurer; Herbert S. Sisson of Albany, executive secretary; Harry R. Hayes of Albany, engineering secretary; F. B. Dyer of Albany, publication manager; F. J. Collins of Rochester, John H. Bolton of Watkins Glen, J. C. Haynes of Watertown, M. J. Molloy of Yonkers, Owen P. Williams of Oneonta and Charles Heiling of Lindenhurst, directors.

MASSACHUSETTS HIGHWAY ASSOCIATION

At the February meeting of the Association which was addressed by William F. Williams, Commissioner of Public Works, and Wesley E. Monk, State Insurance Commissioner, the following officers were elected for the ensuing year: President—Pehr G. Holmes; Vice-President—Arthur E. Blackmer; Secretary—John M. McCarthy; Treasurer—Charles A. Brown; Directors—John A. Gaffey and Franklin C. Pillsbury.

AMERICAN ASSOSIATION OF ENGINEERS

The 14th annual convention, American Association of Engineers, will be held in El Paso, Texas, on June 4, 5 and 6, 1928, with Headquarters in Hotel Hussman. L. M. Lawson, First National Bank, El Paso, Texas, is chairman of the local committee, and M. E. McIvor, 63 E. Adams St., Chicago, is secretary of the Association.

NATIONAL CONFERENCE ON CITY PLANNING

The 20th annual meeting of the conference on city planning will be held at Fort Worth and Dallas, Tex., May 7 to 10. On the program are "City Planning in Fort Worth," by C. P. Capps, Chairman Plan Commission; "The Fort Worth Park Plan," Miss Margaret McLean;

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Trucks move easily, quickly and safely on METALRUT . . . through mud, sand and snow . . . over washouts and drifts . . . to reach their destination without the usual costly traffic delays.

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Books For Sanitary Engineers

MUNICIPAL

and

RURAL SANITATION

By

V. M. Ehlers and E. W. Steel

This is a book which will aid the sanitarian and student of sanitary engineering in coping with some of the widely varying problems which are now presented to the sanitary engineer for solution. In addition to sewage disposal and water supply, the book discusses such topics as sanitary work in swimming pools, food, refuse problems, control of pests, plumbing inspection, housing, etc. Published in 1927, 448 pages, \$4.00.

MOSQUITO ERADICATION

W. E. Hardenburg

A systematic presentation of the best practice in mosquito eradication. The book takes up every phase of the problem. It shows the need for mosquito eradication, outlines plans for specific conditions, describes methods that have proved successful, and contain much supplementary material of value to sanitary engineers, public health officials, and members of mosquito eradication commissions. 248 pages, 6 x 9, 146 illustrations, \$3.00.

Order from

Public Works Book Dept. 243 West 39th St. New York

Books for Highway Engineers

PRINCIPLES OF HIGHWAY ENGINEERING

By C. C. Wiley

A thorough discussion of the fundamentals of highway engineering. A general survey of the field is first given. Then comes a discussion of the materials employed. This is followed by the technical combination of the materials into highway structures. With this knowledge as a background the broader fields of design, finance and operation can be taken up in an intelligent manner. 587 pages, 6 x 9, illustrated, \$4.00.

New 1927 Fourth Edition HANDBOOK FOR HIGHWAY ENGINEERS

By W. C. Harger and E. A. Bonney

The New Fourth Edition is in every way a bigger and better handbook. It gives the practical working data needed for the general planning and for the detail work of surveys, design and construction. It meets the need for a manual covering the ever-growing demands of modern motor traffic. Two separate volumes, when purchased together--\$7.00.

Complete One-volume Edition, Flexible,

HIGHWAY CURVES

HIGHWAY CURVES

And EARTHWORK

By Thos. Hickerson

This handbook offers a compact treatment of the problems of highway location with special emphasis on the subject of curves and earthwork, including the banking and widening of pavements. The economic and aesthetic advantages of easement spirals are fully explained and a large variety of original tables are presented to facilitate the layout of these curves. 382 pages, pocket size, flexible, \$3.50.

Order all books from

Public Works Book Dept. 243 West 39 St., N. Y. C. a symposium on Mass and Density of Buildings in Relation to Open Space and Traffic Facilities; "Planning Procedure in Smaller Cities," by Jacob L. Crane and Stephen Child; "Profits in Community Planning," by Edward M. Bassett; "Airports and Airways as a Part of City and Regional Planning," by John Nolen; "Developing New Subdivisions," by George H. Herrold; and "The Relation of the Plan Commission to Other Departments of the Government," by Alfred Bettman, and Col. U. S. Grant, 3rd.

PERSONALS

F. Earle Harrison, formerly city engineer of Schenectady, has recently become associated with the firm of Metcalf & Eddy, New York City office.

Frank R. Lanagan has succeeded F. Earle Harrison as city engineer of Schenectady. Mr. Lanagan was formerly city engineer of Albany and was deputy state engineer under the administration of Roy G. Finch.

Sturgis Hooper Thorndike, President of the Northeastern Section of the American Society of Civil Engineers, and a member of the firm of Fay, Spofford & Thorndike, consulting engineers, Boston, died February 16. He was a member of the American Society of Civil Engineers, Boston Society of Civil Engineers, and New England Water Works Association.

CIVIL SERVICE

Senior Engineering Draftsman.—Applications to April 14 to fill vacancies in Patent Office and similar positions. Entrance salary \$1,860. The duties consist principally of making perspective drawings from sketches or models, making drawings from rough drafts and specifications, and making trade-mark drawings. All of this work requires high-grade ability as a draftsman and letterer.

Competitors will be rated on perspective drawings, trade-mark drawing and lettering, and drawing from rough draft and specification.

Scientific Aid and Laboratory Apprentice .- Applications to April 14 for Assistant Scientific Aid (\$1,500), Junior Scientific Aid (\$1,320), Under Laboratory Apprentice (\$1,140), Minor Laboratory Apprentice (\$900). To fill vacancies in Departmental Service, including Bureau of Standards. Optional subjects for the position of assistant scientific aid are general physics, ceramics, chemical engineering, chemistry, civil and mechanical engineering, electrical engineering, paper technology, physical metallurgy, physics and chemistry, and textile technology. For the positions of junior scientific aid and under laboratory apprentice registers of eligibles will be established of those qualified in physics, those qualified in chemistry, and those qualified in both physics and chemistry.

For the position of minor laboratory apprentice applicants must be examined in either physics or chemistry.

Full information on the above may be obtained from the United States Civil Service Commission at Washington, D. C., or the secretary of the United States civil service board of examiners at the post office or customhouse in any city.

BOOK REVIEW

The Chemistry of Water and Sewage Treatment. By Arthur M. Buswell, Chief, Illinois State Water Survey, and Professor of Sanitary Chemistry, University of Illinois. 58 illustrations. 362 pages. The Chemical Catalog Co., N. Y., \$7.

This book deals solely with the chemistry of the various purification processes at present applied to water and sewage. It covers very briefly the matter of design, construction and operation of mechanical devices, but aims to present as completely as possible information available concerning the chemical reactions in the various processes. Prof. Buswell considers these treatment methods to be just as truly chemical manufacturing processes as are the production of sugar and dyes. Variations in quality and quantity are great; and the lack of a yard-stick to apply to purification processes is a difficulty.

Under water treatment, are considered colloiods, the composition of water, and the economic disadvantages of unsuitable waters. In addition to industrial water treatment, and special methods of treatment, there are considered the problems of filtration and disinfection, odors and tastes, and the chemistry of coagulation. The data regarding sewage and sewage treatment is equally complete and valuable, covering such fields as sludge digestion, microbiology of sludge reduction, removal of colloids by filters and by the activated sludge method, and the microbiology of colloid removal.

TRADE PUBLICATIONS

Loading Layouts.—The Barber-Greene Co., Aurora, Ill. 36 pages, ill. A valuable handbook giving loading layouts suitable for building construction and supply, gravel handling, city and rural paving and highway work, snowhandling, and loading and unloading cars.

Safety Factors on Steel Posts.— Sweet's Steel Co., Williamsport, Pa., describes a new and practical method which enables anyone contemplating the building of any type of wire fence to analyze wind loads and stresses and thus arrive at the scientifically correct size of steel post required for his particular purpose.

Speed Up With Air.—Sullivan Machinery Co., Chicago, Ill. 32 pp., 2-colers, ill. Shows many different applications of portable air compressors and compressed air tools and processes, in

construction in highway, and municipal fields, including such jobs as mountain highway building in Glacier National Fark, driving a water power tunnel in New Brunswick, excavating rock under water in Chile, highway maintenance in Milwaukee, erecting steel tanks, sinking bridge caissons, driving sheet piling, digging clay in trenches and culverts, removing old foundations, spraying concrete, etc.

Municipal Refuse Incinerator. Pittsburgh-Des Moines Steel Co. 24 pp. Ill. This booklet treats briefly the problems of municipal refuse disposal, and then considers incineration in some detail. Considerable data of value are arranged in easily accessible form. The design of the U. S. Standard incinerator is discussed, and a number of installations are described. A list of installations is appended.

Steel Sheet-Piling, Larssen's Systems: 125 pp. Ill., Sheet Piling, Inc., N. Y. A general catalog showing foot weights, section moduli and data regarding uses under many conditions of work.

A B C of Hydrogen Ion Control. 124 pp. III. La Motte Chemical Products Co., Baltimore, Md. More than one hundred authorities on water supply have aided in compiling the material in this book, about 60 per cent of which is given over to a discussion of the theory and applications of hydrogen ion control. This book, which should be of value to all waterworks men, may be obtained without cost upon request.

Schramm Air Compressors. 40 pp., Ill., Schramm, Inc., West Chester, Pa. This is a catalog describing Schramm products, but it also gives data regarding the use of this equipment on a large variety of work, such as rock drilling, sewer trenching, calking pipe joints, breaking pavements, spading, tamping, driving piles and spray-painting.

Manual of Snow Control. 48 pp., Ill., The Rotary Snow Plow Co., Minneapolis, Minn. In addition to listing the equipment of this company, this booklet discusses interestingly and at length the economic factors determining the scope of snow removal operations. There are discussed the purpose of snow control, the methods of snow control, equipment

for snow removal, and the use of the rotary plow.

Westinghouse Electrical Catalog, 1928-1930.—The 1928-1930 catalogue of electrical supplies of the Westinghouse Electric and Manufacturing Company presents the electrical and mechanical features and application information for all supply apparatus and appliances manufactured by the Westinghouse Company, and in addition describes and illustrates a representative list of large motor and generating apparatus. 1,200 pages.

INDUSTRIAL NOTES

Barber-Greene Co., Aurora, Ill., has established a branch office at 431 Temple Bar Building, Cincinnati, O., which will be under the supervision of Paul Frederick, District Manager.

The Allis-Chalmers Manufacturing Co., Milwaukee, Wisc., has purchased the Monarch Tractors Corp., Springfield, Ill., and will enlarge the plant so as to increase the production of tractors.

Harry E. Cotton, formerly assistant city engineer of Omaha, Neb., has been appointed municipal engineer of the Arnico Culvert Mfrs. Assn. Mr. Cotton spent 19 years in the engineering department of the City of Omaha, the last six years as assistant engineer in charge of all street improvements.

Herbert M. Hein, who for over twenty years has specialized in foreign trade, assumed, as of February first, the management of the Water Meter exports of the Hersey Manufacturing Company. An export office of the Company has been established at 152 West 42nd Street, New York City. The rapidly increasing foreign business of the Hersey Manufacturing Company has made necessary the establishment of this foreign department which has been organized to give special attention and service to foreign purchasers of the Company's water meters.

Factory output of Dodge Brothers passenger cars and Graham Brothers trucks during the month of February from the plants of Dodge Brothers, Inc., in the United States and Canada, according to preliminary figures was 20,727 units, a gain of 25.9 per cent over February last year when the total was 16,463. The gain over January this year, when 12,764 units were shipped, is 62.3 per cent.

3C Calcium Chloride, widely used in curing concrete, for brine solutions in refrigeration processes and for road dust prevention, is now handled direct with the trade by its manufacturers—the Columbia Chemical Division of the Pittsburgh Plate Glass Company located at Barberton, Ohio. The former selling agents of 3C Calcium Chloride—the Carbondale Calcium Company, has been purchased by Columbia. This new arrangement will save time and increase the service to the trade.

Bay City Dredge Works, Bay City, Mich., recently shipped a trainload of Bay City Tractor Shovels to Town Boards and County Commissioners. This shipment, comprising seven machines went to various points, including two town boards in New York, and to Colorado and British Columbia.

The Alabama Rock Asphalt Corporation, Sheffield, Ala., recently shipped a trainload, consisting of 30 cars, of rock asphalt to New York where it will be used in paving roads in the Palisades Interstate Park.

An article entitled "Charleston's Two Million Gallon Elevated Tank," by J. E. Gibson, Manager and Engineer of the Waterworks Department at Charleston, S. C., and delivered before the New England Water Works Association in 1927 has been reprinted for free distribution by the Chicago Bridge and Iron Works.

H. C. Beckwith has returned to The Byers Machine Company, Ravenna, Ohio, as president and general manager. His return to active management of the affairs of the company is in line with the expansion program which has been undertaken by Byers, which has recently purchased The Massillon, Ohio, and has announced a very complete line of shovels and cranes, including new Byers Bear Cat models, both half and full revolving, and Byers-Massillon gas, electric and steam powered shovels of 1 and 1½ cubic yard capacity.

(Continued on page 50)



TRAINLOAD OF BAY CITY TRACTOR SHOVELS FOR TOWNS AND COUNTIES.



"CATERPILLAR" 60, WITH BLADE GRADER ON PLYMOUTH ROAD, WAYNE CO., MICH.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

REX "MECHANICAL MAN"

The Chain Belt Co., Milwaukee, Wisc., has developed the Rex "Mechanical Man," an automatic high speed device by which, on a day's run, the Rex operator is relieved of over 2,000 manual operations.

The result is accomplished by a very simple mechanism. Three cams and three levers—connected to the skip hoist, the water valves, and the discharge chute—perform all operations with sureness and accuracy. As a result, the advantages of the Rex Mechanical Man, which is simply automatic high-speed paver operation, can be definitely stated in seconds saved on every batch, in increased yardage per hour, and in dollars and cents per day.

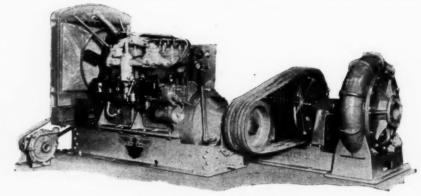
The dribble in discharging occurs at the last end of the batch. It results in the separation of concrete which is noticeable when discharging the last few feet of concrete from the drum. Shutting off the discharge at the end of the 8 or 10 seconds eliminates this dribble and prevents the separation of the fine and coarse aggregates at the last end of the discharge.

The Rex Mechanical Man regulates and controls the discharging action. It discharges full batches of uniformly mixed concrete in 8 seconds by automatically shutting off the discharge at the end of a fixed period, and carrying over a constant amount of concrete into the next batch.

Field tests, it is said, show that shutting off the discharge in 8 seconds insures the discharge of a fixed amount of concrete equal to the amount which is added in each successive batch. In other words, the Rex automatic 8-second discharge clears the drum and prevents any accumulation or building up of the concrete in the drum beyond the amount normally carried over and remixed with

each succeeding batch. This holds true when mixing any size batch which can be handled in the 27-E Rex, or when mixing the concrete to any desired consistency. These field tests show that with sufficient concrete in the drum to

end of the engine. On test the unit delivered in excess of 1000 gallons of clear water per minute, or more than 30 cubic yards of solids, to a maximum height of 60 feet. This outfit has proved to be a popular type for contractors and has a



CLIMAX SAND PUMP DRIVE

permit the buckets to carry full during the entire discharge period, the Rex 27-E will discharge approximately 35 cubic feet of mixed concrete in 8 seconds.

CLIMAX SAND PUMP DRIVE

The Climax Engineering Company, Clinton, Iowa, has developed a unique drive for sand pumps where it is not advisable to direct connect the engine to the pump. On one installation a Climax Model R4U, 6 x 7, 85 H. P. engine, was connected to a 6-inch sand pump with a special drive. This drive was taken from the engine by a twin disc inclosed clutch and through a Texrope drive which furnished the necessary speed reductions between the engine and the pump, permitting the engine to operate at 950 RPM and the pump at 625 RPM. Provision was also made for driving a service or priming pump from the front

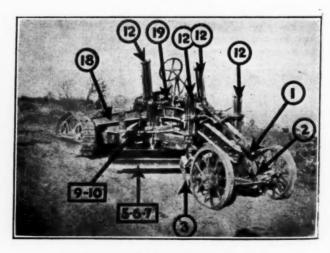
large field for use on barrel type dredges to pump sand and gravel from the bottom of a river or lake to a sorting or screening bin on the shore or at the top of a hill.

SCOTTDALE HYDRAULIC ROAD GRADER

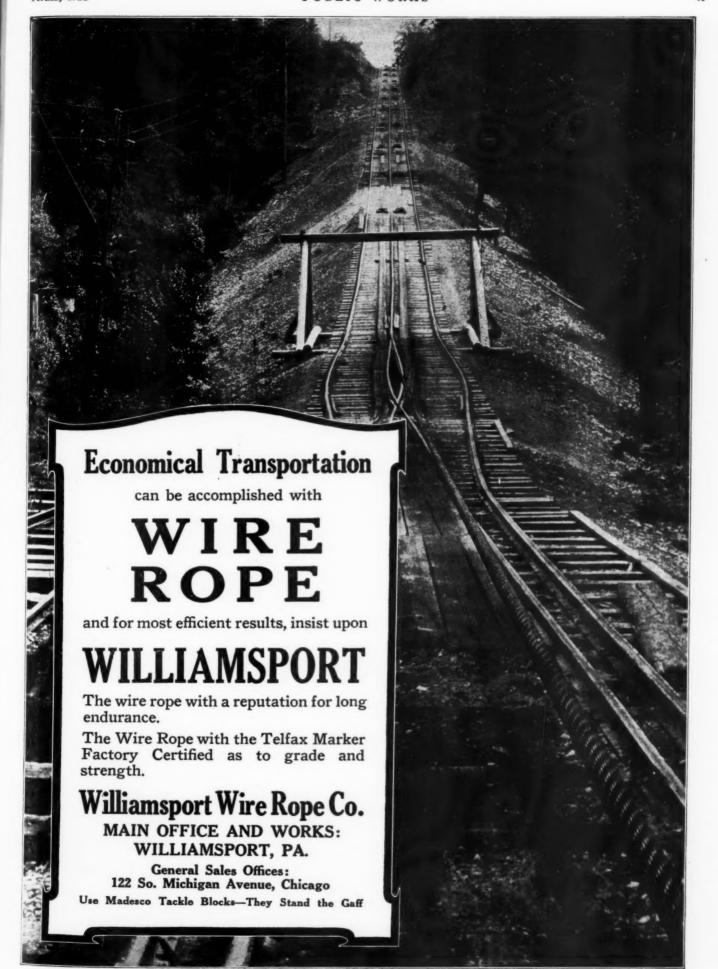
The Marion Machine, Foundry & Supply Co., Marion, Ind., has brought out the Scottdale hydraulically controlled road grader. A 10-20 McCormick-Diering tractor furnishes the power for this machine, which utilizes hydraulic power to operate the blade and scarifier, thus eliminating worm gears, pinions, screws and hand wheels. A slight movement of the operating levers produces action with practically no physical effort. A detailed description follows, the numbers referring to the numbers in the accompanying illustration:



REX "MECHANICAL MAN"



SCOTTDALE HYDRAULIC GRADER



1. Head type steering gear with (a) standard cut worm and worm gear, (b) clearance between worm and gear adjustable to take up wear, (c) roller bearing thrust at each end of worm, (d) worm adjustable for wear, (e) shock absorbing drag link; 2. Three hundred and fifteen pound head casting provides sufficient weight to hold down front end; 3. Independent scarifier, (a) separate or simultaneous control of sides of scarifier make leveling possible, (b) scarifier completely controlled with one lever, (c) ready for use at all times the same as the blade, (d) angle at which scarifier teeth enter ground adjustable by changing

ter, quicker and more efficient work. Operator has a clear vision of blade and scarifier at all times.

NEW CLETRAC "40"

The Cleveland Tractor Co., Cleveland, O., has just brought out a new tractor, the "40," which completes the Cleveland line. In this latest model, as in other Cleveland tractors, there is provided ample power, positive traction, speed and the "one-shot" lubricating system. The motor of the "40" is 6-cylinder, water-cooled, 4½-inch bore and 5-inch stroke. Valve diameters are 2½ inches. Force feed lubrication is provided for the

front spring is compensated for by the oppositely operating action of the crossbar. The action is just as the name indicates; i.e., an equalizing action that distributes the load equally to both front springs, and thus maintains the rail-load in constant balance.

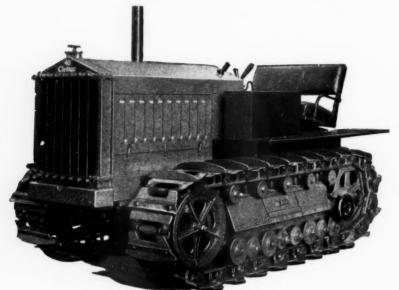
It is claimed that when a gasoline locomotive is operated over temporary, rough tracks, this equalizing device increases the flexibility of the locomotive, since it tends to keep the weight of the locomotive in constant balance, so it can ride very rough track not only safely, but much more smoothly.



The Sullivan Machinery Co., Chicago, Ill., manufacture the Sullivan Pavement Testing Core Drill. This is operated by a gasoline engine, weighs 772 pounds and is intended to be mounted on the rear end of a motor truck. It drills a 65%-inch hole, removing a 6-inch core at the rate of one foot in 15 to 20 minutes. From 20 to 30 samples per 8-hour day may be taken. With the core barrel usually furnished, this machine will drill to a depth of 18 inches.

In operation, the outfit is mounted on the rear end of a light truck. In starting the hole, a guide made of plank is laid on the pavement. The operator stands on this board, and the core barrel passes through a hole just large enough to admit it. The bottom of the barrel is thus held firmly for starting the hole in the concrete. A small handful of shot, and a pint of water are poured into the core barrel, which is open at the top. From time to time more shot and more water are added, although but little shot is required. The shot find their way into two vertical slots cut in the bottom of the core barrel, and from these roll under the face of the barrel. As they roll, the pressure of the barrel crushes the concrete beneath them. The water serves to wash out the ground up material and to keep the barrel from wearing too rapidly.

The speed of rotation recommended is about 100 R. P. M., although this speed may be varied when desired, by the engine throttle.



NEW CLETRAC "40"

one pin, (e) special tough wear-resisting steel teeth, (f) scarifier well up out of the way when not in use; 4. Drawbar, reinforced and twice the usual section; 5. Mold-board, adjustable sideways in 5" steps.

6. Reinforced mold-board; 7. Blade completely controlled by one lever, (a) elevation of ends of blade may be adjusted separately or simultaneously with one hand; 8. Engine supplies the motive power—the hand directs it with a minimum of physical effort; 9. Combination double-end side crank and hydraulic nump. 10. Simple efficient goar nump.

pump; 10. Simple, efficient gear pump.

11. Bearings 1½" to reduce wear;

12. Hydraulic operating cylinders (non-freeze) reduce chatter to a minimum by eliminating the worm and gear type lifting mechanism; 13. Duplicate parts are used in many places to insure simplicity;

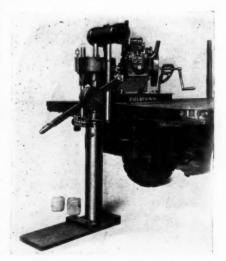
14. Parts are machined in jigs and fixtures assuring a fit when a repair part is required; 15. Parts are made by production methods making replacements reasonable in price.

16. A comprehensive record is kept of each machine sold so that parts can be shipped immediately upon receipt of order; 17. Structural steel parts are used wherever possible, replacing castings that might prove defective at a critical time; 18. The frame is made from 7"—17½ lb. I-beam with no holes in flange; 19. Center control enables operator to do bet-

crank shaft, connecting rods, cam shaft, and valve rocker shaft, and splash lubrication elsewhere. The fuel tank capacity is 40 gallons, and the tank is mounted on the right hand fender. The tubular radiator has a capacity of 8 gallons. There are three speeds forward and one reverse; the low speed giving a speed of 2.2 miles per hour, intermediate 3.6 miles, and high 5.7 miles. Reverse speed is 2 miles per hour. Steering is accomplished by the effect of the motor through a planetary compensating differential, making steering easy. The track shoes are 14 inches wide, with 10-inch pitch; grouters are 2½ inches high and 17 inches wide. There are 24 carbon steel shoes in each track. Length on the ground for each track is 80 inches. Total tractive surface is 2,240 square inches and the ground pressure is 41/2 pounds per square inch. The power take-off shaft operates at a speed of 560 R. P. M., with a belt speed of 2,900 feet per minute.

IMPROVED GASOLINE LOCOMOTIVES

The Geo. D. Whitcomb Company, Rochelle, Illinois has perfected a cross equalizing device that gives an additional advantage to Whitcomb gasoline locomotives. The device consists of a crossbar centrally pivoted on the front of the frame so that any excess load on either



SULLIVAN TESTING DRILL





But Not Tor Long

PRICES

SIXTY . . . \$4600 THIRTY . . \$2650 TWENTY . \$2175 F. O. B. Peoria er San Leandre

2-TON . . . \$1675

THE faith of this contractor in the dependability of his "Caterpillar" leads him to assure the traveling public that the job of road repair will be carried to swift completion...that the detour signs will come down quickly. "Other contractors please copy!



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BEST C. L. Best The Holt Manufac-HOLT

There is a "Caterpillar" Dealer near you.



PIPE LINE TRACYFIER

Andrews-Brodshaw Co., Division of Blaw-Knox Co., Pittsburgh, Pa., have just developed a small purifier for use on several sizes of air, steam or gas lines up to 3 inches in size. There are many uses for a complete-separation purifier

designed for installation where running water is not available. It is especially suited for use in garages and roadside comfort stations where the use will be severe and attention infrequent; it is also desirable for use in outdoor camps. Because all wastes are sterilized, this

Rissia Milli Par

DURKEE-ATWOOD WHEELS ON RUSSELL MOTOR PATROL

of this size; in steam lines to gas producers to maintain a more uniform hydrogen content in the gas; in the steam lines leading to the tar burners on open hearth furnaces, where the use of completely dried steam effects a three-fold purpose, producing a shorter, hotter, more uniform flame, saving about a gallon of tar per ton of steel, and keeping the checker chambers cleaner. Placed ahead of laundry or paper driers, the Pipe Line Tracyfier has been found to increase greatly the output of the machines. Perfectly clean air can be obtained for use in air tools by the use of a Pipe Line Tracyfier in the air line near the tools. One Tracyfier will dry and clean the air for several tools. This results in a lowering of out-of-service time and an increase in output per tool. Whenever a gas carries drops of liquid that it is desirable to remove, either for recovery, or elimination, the Pipe Line Tracyfier will accomplish perfect separation.

WATERLESS TOILETS

The Chemical Toilet Corporation, Syracuse, N. Y., have just brought out a new style of waterless toilet which is

14-INCH TRACYFIER

toilet is of great value for use on water sheds and for waterfront camps where it is desired to prevent any pollution of the water.

Features of interest are the water sealed drop tube, which practically eliminates any chance for odors, and the combined self-drain and drain valve. The self-drain arrangement provides for troubleless operation, while the drain



SAN-EQUIP WATERLESS TOILET

valve allows the tank to be emptied completely by the opening of a valve, which is often desirable at the end of the season.

Tanks are of iron, protected against the possibility of corrosion; sizes are from 60 to 750 gallons, to care for from 4 to 75 people under home conditions, and up to 150 at schools or comfort stations. Bowls are of vitreous china, with oak finish seat.

DURKEE-ATWOOD WHEELS AND

Durkee-Atwood Co Minneapolis, Co., Minn., manufactures wheel and tire equipment for tractors. This equipment is of the sectional type, making it possible to remove or install a tread section using only a wrench. One or all sections may be put on or taken off without removing the wheels from the tractor. Their use, it is claimed, permits the employment of the tractor in soft ground, due to the extra width and the grooving of the tires. This sectional tire and wheel equipment is made in several sizes for the Fordson and McCormick-Deering 10-20, Industrial and 15-30 tractors.

AUTOMATICALLY PRIMED PORTA-BLE PUMP

The American Steam Pump Co., Battle Creek, Mich., has brought out a new portable pumping outfit, the Type MEP, which is equipped with a patented automatic primer. It is claimed that with this device the pump is automatically primed in less than one minute, even in freezing weather. The pump stays primed as long as the engine runs. The primer receives its suction from the engine intake manifold, and is equipped with a float which prevents the possibility of any water reaching the engine. The maximum suction is 20 feet.

This pump, which is equipped with Le Roi engines, comes in capacity of 170 to 1200 gallons per minute with heads of 10 to 15 feet, but can be used on lifts up to 50 feet. Delivery pipes are 2 to 6 inches and suction 2½ to 8 inches. It is designed to handle all classes of drainage work, supplying water for general construction, road building, and similar purposes. The impeller is of the open type and will handle water containing sand, mud or gravel. The outfit is exceptionally light in weight, ranging from 800 to 1280 pounds complete, depending on the



AUTOMATICALLY PRIMED PUMP

Machined first -

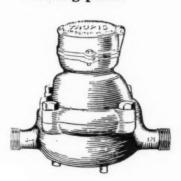


then TINNED

By Hot Dipping
Method

BE sure that the meters you buy have working parts that are machined first then tinned. Meter parts that are machined after they are tinned are not protected from corrosion. Where machining cuts away the tin a raw composition surface remains that is not protected.

Every working part of every Pittsburgh Equitable Meter Company Water Meter is protected 100 per cent by hot tinning after the part is machined. This process assures longer life of working parts.



TROPIC



ARCTIC

BRANCH OFFICES

New York, New York. Chicago, Illinois. Dallas, Texas. Los Angeles, Cal. Tulsa, Oklahoma. Seattle, Washington. Columbia, S. Carolina. Salt Lake City, Utah. Kansas City, Missouri.



PITTSBURGH EQUITABLE METER COMPANY

PITTSBURGH, PA.

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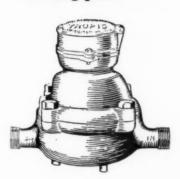


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TROPIC



ARCTIC

BRANCH OFFICES
New York, New York.
Chicago, Illinois.
Dallas, Texas.
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Tulsa, Oklahoma.
Seattle, Washington.
Columbia, S. Carolina.
Salt Lake City, Utah.
Kansas City, Missouri.



PITTSBURGH EQUITABLE METER COMPANY

PITTSBURGH, PA.

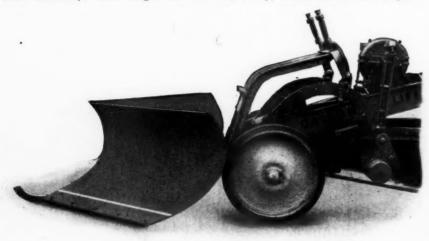
GALION SNOW PLOW

Galion Iron Works & Mfg. Co., Galion, O., have developed a snow plow for use with all Galion motor graders. This is a V shaped plow, properly curved and mounted to move snow. It is made of heavy steel and thoroughly braced. A runner is placed at the front to carry the plow over obstructions and relief springs permit this action at the same time holding the plow to its work. The plow is combined with and operated by the scarifier mechanism (with scarifier teeth removed). The weight of the

made of solid pieces of glass, scientifically designed and constructed so as to provide great strength and extremely efficient reflecting qualities. Being cylinders of solid glass they are practically indestructible and will stand up under very rough handling. They can be destroyed only by deliberate intent.

JONES SUPERIOR SPEEDSTER SAW TABLE

The Jones Superior Machine Co., Chicago, Ill., maker of woodworking machinery, manufactures the Superior



GALION SNOW PLOW

scarifier block is so balanced against the weight of the plow that raising and lowering by means of the self locking, enclosed worm gearing running in oil, is very easy. The attachment is directly at the front of the grader frame and the power is thus carried directly to the snow plow or breaker.

The attachment of this snow plow to any Galion motor grader equipped with a modern Galion scarifier is a simple matter.

This plow opens a six foot path for the grader. The blade following, widens the path and moves the snow to the outside of the road. In deeper snow, the outer end of the blade should be lifted to slope the snow bank and carry the loose snow back from the cut.

RAYFLECTORS

Ray Signs Corp., New Haven, Conn., manufactures a wide variety of directional, highway marking, and other signs, a distinguishing feature of which is the arrangement of lens and reflector so that light rays from a motor vehicle or other source entering the lens from almost any angle are returned with over 75% of their original intensity directly to the source of the light. Thus, signs and symbols made with Rayflectors are instantly and clearly visible to passengers in a motor vehicle as far away as the rays from the motor vehicle's headlights will carry. Ordinary painted signs lensed with Rayflectors have their usual appearance by day and gleam with great intensity at night. Rayflectors need no attention other than that given an ordinary painted sign and will retain their effectiveness indefinitely. They are

Speedster saw table, which is powered with a 1½ horse-power Briggs & Stratton air cooled gasoline engine. This power equipment makes it possible for the contractor to use this machine wherever he wishes, even if electric current is not available. With the 1½-h. p. the outfit will rip 2-inch lumber at the rate of 20 feet per minute, and will cut off 3 x 6 timber in less than 2 seconds. The unit is built almost entirely of steel, and is readily portable.

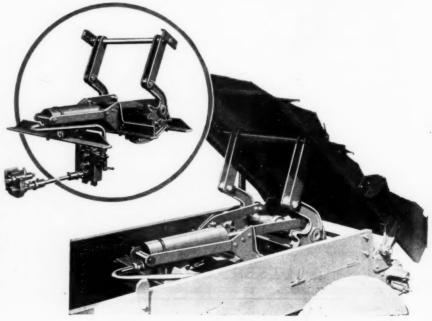
RIDDELL SNOW PLOW

W. A. Riddell Co., Bucyrus, O., has brought out a new snow plow which is attachable to the Hadfield-Penfield grader, making it an all year road machine, earning in winter by snow removal as well as in building and maintaining roads the rest of the year. The plow is easily attached and is operated from the drivers position. It can be lowered, using only the plow on lighter snows or, when snow is heavy, the blade of the grader takes care of the lower snow while the raised plow handles the upper snow, making it possible to remove deeper snow than with either implement used separately. The plow is not expensive and is economical in operation requiring only the one man and making it unnecessary to have more costly equipment which is more expensive to operate and mountain.

WOOD HI-SPEED HYDRAULIC HOIST

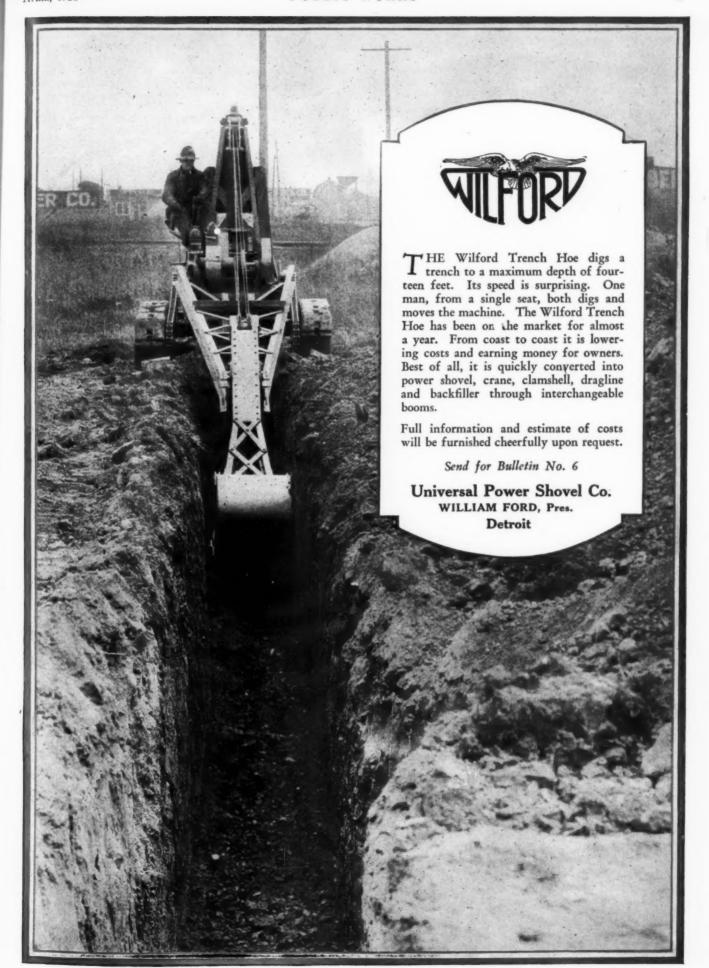
The Wood Hydraulic Hoist & Body Company, Detroit, Michigan, announces the addition of the new G-1, Hi-Speed underbody hydraulic hoist to its line of dump truck equipment. The G-1 Hi-Speed hoist is designed for short wheelbase, light, speedy, pneumatic-tired trucks with close-coupled chassis. It is claimed to be the speediest hoist built, being capable of dumping the load in less than five seconds. It elevates the body to an angle of 60 degrees.

It is primarily designed for contractors, road builders and supply dealers who need power-operated equipment for short wheelbase chassis of the road builder 1-ton and 1½-ton types and demand speed as the first essential. The G-1 is easily installed and simple to operate. It employs the hydraulic principle, deriving its power from the truck transmission. On the roadbuilder chassis it gives all the advantages of a heavier unit, yet with compact, fast operation, flexibility and convenience of handling in the most congested places.



WOOD HI-SPEED HYDRAULIC HOIST

nt



LAKEWOOD IMPROVED GRADEROOTER

The Lakewood Engineering Co., Lakewood, O., has put out an improved Graderooter for 1928. It is equipped with double pointed teeth made of high grade steel, one inch thick instead of single pointed teeth three-quarter inch thick, as previously used. The teeth can be set to root twelve inches deep and forty-eight inches wide. Ten teeth are furnished with each machine. The Graderooter can be used wherever a rooter plow can be employed. A particular advantage is that it will work close to the forms. It is light enough to be pulled by teams and strong enough to stall the heaviest tractor, it is claimed. The Graderooter is also used for maintenance work by a number of State and County Highway Departments.

W. & T. DRY BATTERY FLASHER

Wallace & Tiernan Co., Newark, N. J., have developed a dry battery flasher for traffic guidance.

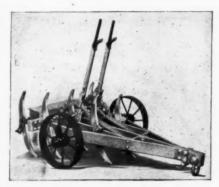
The W&T Dry Battery Flasher is operated from a group of eight 1½ volt dry cells—the same batteries that are used so generally as A batteries in radio sets. Through an electrically operated pendulum mechanism, rapid flashes (60 per minute) of light are obtained from a miniature incandescent lamp properly focused in a parabolic spreading reflector. Recognizing that these electric lamps will burn out on occasion and recognizing further that a signal with a burned out lamp transforms a safeguard into a hazard, there has been developed an ingenious method of immediately and automat-

RE BE EN E

W. & T. TRAFFIC FLASHER

ically replacing with a new lamp a lamp that has gone out of service. The flashers as installed have at least six months supply of batteries and one years supply of lamps.

These flashers were developed with the idea that traffic devices in general belong on the side rather than in the center of the street and therefore a one-way flasher would be particularly serviceable in signaling stop streets, through streets,



LAKEWOOD GRADEROOTER

boulevards, curves, dead ends, railroad crossings, ditches, detours and the like. For those instances where traffic signals must be located in the center of the road, a 360 degree or universal type, giving light in all directions is available.

The W&T Dry Battery Flasher is leased to the user and installed on a service basis.

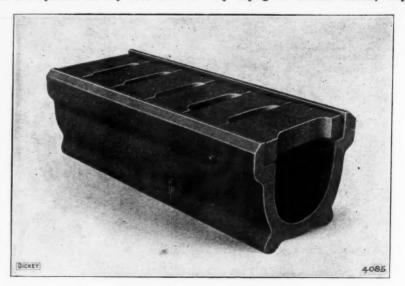
ROGERS HEAVY DUTY TRAILER

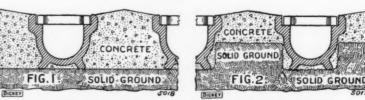
Rogers Brothers Corporation, Albion, Pa., makes the Rogers heavy duty gooseneck trailers in capacities from 1 to 60 tons. These trailers are spring mounted and are operable on any road without injury to load or road. The wheel load does not exceed permissible limits, and the mounting and springs allow easy operation even over rough roads. They can be loaded from side or rear. They are built in 4, 6 and 8-wheel types, all having 4 rear wheels on two rocking axles. In the 8-wheel trailer, this applies to both front and rear wheels, thereby giving tires their full bearing value at all times.

DICKEY UNDERDRAIN TILE

W. S. Dickey Clay Mfg. Co., Kansas City, Mo., has brought out an underdrain tile for use in trickling filters, made of vitrified, salt glazed material and claimed to have several advantages. It is a stock item, always available; it lends itself to economical construction because it is easy to handle, requires no forms and may be aligned and adjusted to proper grade easily and simply. The covers may be applied with equal ease. The use of this tile for underdrains affords good underdrainage facilities and provides for better aeration of the filter. Flushing is simple. The material is unaffected by the sewage.

Construction and design are simplified. The tile may be laid on a filter floor of concrete or of firm soil. Where this latter condition is encountered, a reduction in cost is possible, the construction taking one of the forms shown in Figs. 1 and 2. The tile is laid directly on the soil and the spaces between the channels filled with concrete, providing a built-up floor of concrete and tile. Or the tile may be placed directly on a concrete floor, in which case they are generally pushed into the soft concrete about 1/2 inch, and the spaces between are then filled with lean concrete. A cap coping of cement mortar, sloped





DICKEY UNDERDRAIN TILE AND METHOD OF USE

ONLY THE BARBER-GREENE. HAS THE DISC FEED



Here it is: 1. B-G Loaders are fast. Every bucket takes a heaping measure — and clean-up is clean. 2. B-G repair bills are practically nil.

Here's why: 1. Two flat revolving discs (patented) edge into and under the pile—making sure that each up-coming bucket is filled brimming to the top.

2. The floating boom (patented) rides rough ground—keeping strains and twists away from the loader itself. Wear and tear is slight.

See how others have ing costs. Ask for

learned the low down on low loadour book "Loading Layouts." THE
LOW DOWN
ON
LOW COSTS

Barber-Greene Company 635 W. Park Avenue, Aurora, Ill.

Disc Feed Barber-Greene

LOADERS

Model waste 1

Model "42"-11/4 yards per minute

Model "28"—wheel mounted

both ways, insures quick drainage. The sections may be placed about 18 inches on centers; each section is 24 inches long, 6 inches in effective width at the top, and $4\frac{1}{2}$ inches deep. The approximate end area over all is 55 square inches, and inside 23.14 square inches. Minimum thickness is $\frac{1}{2}$ 8 inch and the approximate weight of a section, including 6 covers, is 30 pounds.

PERFORATED CONCRETE ROLLER

The Perforated Roller Concrete Works, Kankakee, Ill., manufactures a perforated roller which is designed to accomplish the scientific compacting and finishing of concrete pavements. This rolcut worm for side shifting moldboard, enclosed worm steering gear and many other proven features combine to make this a very satisfactory and easy operating motor grader.

The field of this grader is extended and its usefulness increased by three very practical attachments: The scarifier, controlled from the operator's platform by machine-cut worm gearing operating in oil; the snow plow which is attached to the front end of the grader and operates in connection with the blade, to open a wide path through drifts and fairly deep snow; the multiple blade which is attached, instead of the regular blade, for certain types of maintenance work.

The comfort of the operator on this motor grader has been served not only by ease of operation and accessibility of controls but also by a shelter cab, with curtains when desired, and heavy fenders over tracks.

The uses of this motor grader are numerous, though it is primarily used in road maintenance. It will level roads and restore

grades very rapidly. It will also maintain berm at the sides of paved roads, peel sod at road-sides and clean ditches.



GALION CATERPILLAR GRADER

ler, which does not shift or push the mortar ahead of it, it is claimed, forms indentations which permit entrained air and surplus water to escape. It has only compressive action, and does not bring surplus mortar or foreign matter to the top of the pavement. The roller is made in various sizes and weights for finishing pavements, sidewalks, floors, etc.

GALION CATERPILLAR TRACTOR POWERED GRADER

The Galion Iron Works & Mfg. Co., Galion, O., have brought out a new Galion heavy duty motor grader with the Caterpillar 2-ton tractor as the power unit. Cast steel brackets form the main attachment between grader and tractor while the attachment at the front of the

tractor is by means of a spring-mounted yoke. The removal of four clamps and a few control extensions makes it possible to raise the grader frame and remove the tractor for separate use.

Machine-cut EZ lift gearing, operating in oil at the bottom of an oil tight gear case, sturdy lift springs, 40-inch lift wheels, extra curved moldboard, in 8. 10, 12 and 14-foot lengths, machine-

LITTLE GIANT HOIST

Steinke Bros. Co., Peoria, Ill., manufactures the Little Giant truck hoist for use in Ford, Chevrolet, Graham Bros., Reo and other 1 and 1½-ton trucks. It is claimed that by the use of these hoists a standard truck may be converted into an all-purpose body. The Little Giant fits the truck for dumping or straight hauling without any alterations or change of parts. It is lock geared and equipped with roller bearings and is claimed to lift any load with ease, to dump quickly and smoothly and lock automatically at any desired angle. It

is stated that it will fit any standard body of any ordinary capacity. It comes complete with malleable hinges and crank. The "A" frame is made of angle iron and the chain wheel at the top is equipped with roller bearings assuring strength and operating ease.

Little Giant fits the body snug up against the cab and down tight to the frame preventing vibration or side-twisting.

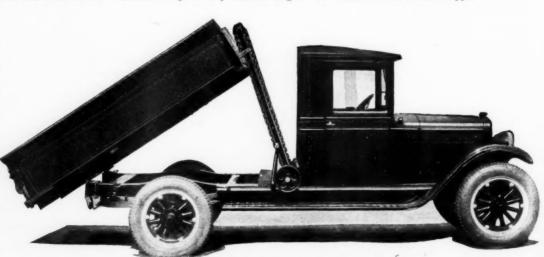
INDUSTRIAL NOTES

(Concluded from page 39)

William C. Sherwood, who has been connected with the New York branch of the Hersey Manufacturing Company for nearly thirty years, for the last twenty of which he was its manager, has become assistant to the president and will make his headquarters at the main office of the company in Boston. The increasing business of the Hersey Manufacturing Company has, in recent years, made it impossible for the president, Walter A. Hersey, to keep in close touch with the many customers of the company and with its several branch managers, and Mr. Sherwood's appointment will make it possible for him to spend more time among his friends and the sales organization.

William B. Cambridge, who has been connected with the Hersey Manufacturing Company for twenty-four years, part of which time was spent in the factory at Boston and in recent years in the sales organization with Mr. Sherwood in the New York division, will succeed Mr. Sherwood in the management of this branch. Mr. Cambridge is especially well equipped to assume the responsibilities of this appointment because of his wide experience in production and distribution.

The Climax Engineering Company, of Clinton, Iowa, announces the appointment of the Equitable Equipment Company, 410 Camp Street, New Orleans, La., as a Climax sales and service representative for the territory of lower Louisiana and Mississippi.



STEINKE BROS. LITTLE GIANT HOIST